

SELECTED  
WATER  
RESOURCES  
ABSTRACTS



VOLUME 15, NUMBER 2  
FEBRUARY 1, 1982

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# **SELECTED WATER RESOURCES ABSTRACTS**

A monthly publication of the Office of Water Research and Technology,  
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

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## PREFACE

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology  
U.S. Department of the Interior  
Washington, D.C. 20240

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# SELECTED WATER RESOURCES ABSTRACTS

## 1. NATURE OF WATER

### 1A. Properties

**A MATHEMATICAL MODEL FOR CONSOLIDATION IN A THERMOELASTIC AQUIFER DUE TO HOT WATER INJECTION OR PUMPING,**  
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2F.  
W82-00602

**GRAVITATIONAL STABILITY OF WATER OVER STEAM IN VAPOR-DOMINATED GEOTHERMAL SYSTEMS,**  
Aerospace Corp., Los Angeles, CA. Space Science Lab.  
G. Schubert, and J. M. Straus.  
Journal of Geophysical Research, Vol 85, No B11, p 6505-6512, November, 1980. 7 Fig, 13 Ref.

Descriptors: \*Geothermal studies, \*Water vapor, \*Stability analysis, Geothermal resources, Mathematical studies, Condensates, Permeability.

The gravitational stability of a condensate or water layer overlying steam in a vapor-dominated geothermal system was investigated. Linear stability analysis was carried out on superposed layers of immiscible fluids in a porous medium and demonstrated that the heavy over light configuration is always unstable. A similar stability analysis was carried out for the case in which the interface separating the fluid layers is a phase change. The phase change was found to stabilize the heavy over light configuration. The conditions under which this stabilization occurs are quantified and applied to the water over steam situation characteristic of vapor-dominated geothermal systems. The condensate layer can be stabilized if the permeability near its base is no larger than about 40 sq mm (0.04 millidarcy). The special behavior of the phase change interface between water and steam permits the stabilization of the system with a nonzero permeability. (Baker-FRC)  
W82-00963

**BUOYANCY FORCE REVERSALS IN VERTICAL NATURAL CONVECTION FLOWS IN COLD WATER,**  
State Univ. of New York at Buffalo. Dept. of Mechanical Engineering.  
V. P. Carey, B. Gebhart, and J. C. Mollendorf.  
Journal of Fluid Mechanics, Vol 97, No 2, p 279-297, March, 1980. 9 Fig, 11 Ref.

Descriptors: \*Temperature effects, \*Natural flow, \*Buoyancy, Mathematical studies, Hydrodynamics, Saline water, Ice, Freezing, Melting.

Calculated transport is compared to experimental transport for laminar buoyancy-induced flows driven by thermal transport to or from a vertical isothermal surface in cold pure and saline water. Specifically, the consequences of temperature conditions wherein the buoyance force reverses across the thermal region owing to the presence of a density extremum are explored. This is a common condition in terrestrial waters and in technological processes utilizing cold water. A nonlinear density equation of state for both pure and saline water is presented which permits an accurate treatment of flows for bounding temperatures up to 20 deg C at salinity levels from 0 to 40 ppt and pressure levels from 1 to 1000 bars. Applications include the melting or slow freezing of a vertical ice surface in pure water as well as a heated or cooled vertical isothermal surface in pure or saline water. Calculated transport agreed well with experimental results. The results indicate that such flows are relatively weak but can lead to early laminar instability. (Small-FRC)  
W82-00981

**FLOW ANALYSIS OF MODELS OF THE HUBBARD BROOK ECOSYSTEM,**

Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.

J. T. Finn.  
Ecology, Vol 61, No 3, p 562-571, 1980. 7 Fig, 7 Tab, 19 Ref.

Descriptors: \*Flow characteristics, \*Ecosystems, Model studies, Flow measurement, Flow profiles, Flow rates, Flow system, Cycling nutrients, Nutrients, Energy.

Flow analysis, a method of tracing flows of materials through a system, was applied to some of the Hubbard Brook data to determine the amount cycled per year of several elements and energy at Hubbard Brook compared to the total amount of each flowing per year in the system and also determine the pattern of nutrient and energy flow in the ecosystem. Three different models of calcium flow were compared to judge the effect of small differences in model structure on cycling and flow pattern. When all three models were analyzed using the same nutrient flux data, flow measures became very close, in spite of structural differences in the models. For these models, flow values were more important than the architecture of the models in determining cycling and flow characteristics. Flow analysis offers a new set of tools to investigators of biogeochemical cycling, which enables comparisons between elements and across systems, and which also may serve as an aid in evaluating models of cycling. (Baker-FRC)  
W82-01038

### 1B. Aqueous Solutions and Suspensions

**AQUASOLS: THE BEHAVIOR OF SMALL PARTICLES IN AQUATIC SYSTEMS,**  
Johns Hopkins Univ., Baltimore, MD.

C. R. O'Melia.  
Environmental Science and Technology, Vol 14, No 9, p 1052-1060, September, 1980. 11 Fig, 3 Tab, 13 Ref.

Descriptors: \*Physical properties, \*Water pollution, Reviews, Water resources management, Water demand, Water quality, \*Particulate matter, Water treatment facilities, Wastewater treatment, Water transport, Conveyance structures, Aqueducts, Aquifers, Natural waters, Lakes, Temperature effects.

This article describes the physical processes that affect transport and fate of solid particles in aquatic systems and illustrates, using case studies, the present understanding of these processes and the extent of their effects. Three physical processes are considered: Brownian or molecular diffusion, in which random motion of small particles is brought about by thermal effects; fluid shear (either turbulent or laminar); and gravity, which produces vertical transport of particles and depends on the buoyant weight of the particles. Four case studies are summarized. Two are examinations of particle deposition at water-solid interfaces: filtration by packed beds in laminar flow, and deposition on pipe walls in turbulent flow. The other two examples consider particle transport within aquatic systems: a water treatment plant and a lake. Current available evidence suggests that most pollutants in water are particles or are associated with particles. These particles are governed by physical processes. Knowledge permits these processes to be described and controlled in treatment and transport systems for water supply and wastewater disposal. By extending these concepts to natural aquatic systems, new insights will be found into the functioning of the natural systems and the flow of materials through them. This knowledge will improve man's management of these systems and enable him to more successfully control his impact on them. (Baker-FRC)  
W82-00540

**ADSORPTION ON CARBON: SOLVENT EFFECTS ON ADSORPTION,**

For primary bibliographic entry see Field 5F.  
W82-00619

**ELECTRICAL ASPECTS OF ADSORBING COLLOID FLOTATION. XI. SURFACTANT ADSORPTION ISOTHERMS, PARTICLE DISPLACEMENT, AND DIFFERENTIAL CAPACITANCE,**

Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.  
J. E. Kiefer, and D. Wilson.  
Separation Science and Technology, Vol 15, No 1, p 57-74, 1980. 14 Fig, 25 Ref.

Descriptors: \*Bubbles, Statistical methods, \*Adsorption, Isotherms, Temperature gradient, \*Surfactants, Sediment-water interfaces, Electrical properties, \*Air-water interfaces.

The theory of surfactant adsorption of floc particles at the air-water interface was explored. First the adsorption of surfactant onto floc particles to form a hemimicelle was examined; this renders the particles hydrophobic and permits bubble attachment to occur. Statistical mechanics were used to calculate adsorption isotherms of ionic surfactants on charged solid-water interfaces. The effects of coulombic repulsions between the ionic heads of the surfactant species are taken into account, as are the van der Waals attractions of their hydrocarbon tails. A 'squeeze-out' mechanism by means of which viscous drag forces acting tangentially to the surface of a rising bubble may detach floc particles from it is examined. A nonideal Poisson-Boltzmann equation is used to calculate the differential capacitance of the electric double layer at an interface. (Baker-FRC)  
W82-00788

## 2. WATER CYCLE

### 2A. General

**IDENTIFICATION OF STREAMFLOW STOCHASTIC MODELS,**  
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

J. D. Salas, J. T. B. Obeysekera, and R. A. Smith.  
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 853-866, July, 1981. 2 Fig, 5 Tab, 35 Ref.

Descriptors: \*Stochastic processes, \*Streamflow forecasting, \*Model studies, Niger River, Rivers, Hydrologic models, Watersheds, Rainfall-runoff relationships, Groundwater, Autoregressive Moving Average Model.

This paper presents a method for choosing an appropriate stochastic model for annual streamflows. The type of model is chosen on the basis of a conceptual physical representation of a natural watershed, and the form, on the basis of recently developed R-functions and S-functions. Under certain assumptions, for an ARMA (p,q) (Autoregressive Moving Average Model) precipitation input the groundwater storage is an ARMA ( $p+1, q$ ) process and the streamflow is an ARMA ( $p+1, q+1$ ) process. In general, such groundwater and streamflow processes belong to the class of restricted ARMA processes in the sense that their parameter space is a subspace of that corresponding to the general ARMA models. An example shows how the annual flows of the Niger River at Koulikoro, Africa, can be modeled by ARMA (Cassar-FRC)  
W82-00555

**A GEOMORPHOLOGIC SYNTHESIS OF NONLINEARITY IN SURFACE RUNOFF,**  
Mississippi Univ., University. Dept. of Civil Engineering.

C. T. Wang, V. K. Gupta, and E. Waymire.  
Water Resources Research, Vol 17, No 3, p 545-554, June, 1981. 7 Fig, 1 Tab, 24 Ref.

Descriptors: \*Surface runoff, \*Geomorphology, Rainfall-runoff relationships, Hydrographs, Runoff, Rainfall intensity, Predictions, Basins, River basins, Illinois, \*Nonlinear programming.

## Field 2—WATER CYCLE

### Group 2A—General

A nonlinear (quasi-linear) geomorphic approach for modeling the rainfall-runoff process for a basin was developed by generalizing a recently developed linear geomorphic approach (Gupta et al., 1980). The nonlinearity in the transformation enters in partly through the dependence of the mean holding time on the rainfall intensity. Under an assumed first approximation that this dependence is the sole source of nonlinearity, an explicit quasi-linear representation results for the rainfall-runoff transformation. The kernel function of this transformation can be termed the instantaneous response function, whereas the linear rainfall-runoff transformation is termed the instantaneous unit hydrograph. Analysis of a small basin showed agreement between the quasi-linear theory results and the prediction from the kinematic wave approach. For two large (1100 sq miles) basins in Illinois, predictions from the quasi-linear approach compared well with observed flows. Computations of the measure of nonlinearity for four basins showed that it approaches 2/3 with decreasing basin size and zero with increasing basin size. A straight line was formed with a semilog plot of nonlinearity vs. square root of basins area. (Cassar-FRC)

W82-00604

### MULTIVARIATE HYDROLOGIC TIME SERIES ANALYSIS, Ottawa Univ. (Ontario). Dept. of Civil Engineering.

C. T. Hsu, and K. Adamowski.

Advances in Water Resources, Vol 4, No 2, p 83-95, June, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: \*Runoff, \*Mathematical models, \*Watershed management, Model studies, Statistical analysis, Rainfall, Hydrology, Meteorological data collection, \*Streamflow forecasting.

A multivariate watershed hydrologic system model was developed which involves meteorological data as the input and river flow as the output. Monthly hydrological time series of runoff, temperature, and precipitation were analyzed. This autoregressive-moving average transfer function model was adequate to model the monthly watershed system. The accuracy of estimation of runoff characteristics was enhanced with the use of the meteorological and hydrometric data. For watersheds with large storage, the improvement was not pronounced. The large storage effect plays a dominant role in the generating process of system response, and the contribution from external disturbances will be damped out before it becomes significant. To model a multivariate watershed hydrologic system, a combined deterministic-statistical approach could be used. For example, net precipitation rather than gross precipitation could be used as input. (Small-FRC)

W82-00647

### STUDY OF THE FACTORS AND REGULARITIES OF RIVER RUNOFF ON THE BASIS OF DATA OF OBSERVATIONS ON REPRESENTATIVE BASINS,

Hydrometeorological Service of the USSR, Moscow.

V. D. Komarov.

Water Resources (English Translation), Vol 7, No 4, p 293-303, July-August, 1980. 8 Fig, 8 Ref. Translated from Vodnye Resursy, No 4, p 5-18, July-August, 1980.

Descriptors: \*Runoff forecasting, \*Representative basins, \*Snowmelt, Basins, Hydrologic models, Russia, Spatial distribution, Forest watersheds, Watersheds, Small watersheds, Rivers, Snow cover, Soil moisture, Freezing, Vegetation.

River runoff observations were started in representative basins in Russia in 1924. There are 10 water balance stations in European Russia, and others in Central Asia, the Far East, and Maritime Territory. The major concern in the European sector is the spring runoff. The observation program includes runoff measurements, snow surveys, depth of freezing, soil moisture content, groundwater level, and meteorological data. By considering two types of spatial inhomogeneity, methods of

calculation for runoff can be improved. The first is the variation in physiographic conditions, for example, treeless and forested zones. The second is the variation within each part of the water basin equivalent of snow cover, soil moisture content, depth of freezing, storage capacity of closed depressions, etc. The Moscow water balance station is used as an illustration in choosing representative basins. It is not necessary to choose a totally treeless basin and a totally forested basin. Instead, the Medvenka River basin (area 21.5 sq km, forest 0.26) and the Zakkha River basin (area 17.0 sq km, forest 0.73) were chosen. These basins are similar in physiographic conditions, with the exception of forest cover, and are representative of larger basins. Relationships derived from these two representative basins are applied to the 18,000 sq km Chepsta River basin, forest coverage 0.26, similar to the two representative basins in soils, relief, and vegetation. The calculated runoff agreed well with that observed in the Chepsta basin—1974, 172 and 162 mm; 1975, 79 and 77 mm; and 1976, 59 and 56 mm. (Cassar-FRC)

W82-00652

### EFFECTS OF RECENT INCREASES IN RAINFALL ON FLOODS AND RUNOFF IN THE UPPER HUNTER VALLEY,

New South Wales Univ., Kensington (Australia). School of Geography.

For primary bibliographic entry see Field 2E.

W82-00668

### EFFECTS OF TROPICAL CYCLONE WALLY IN SOUTHEAST VITI LEVU, FIJI, EASTER 1980,

Victoria Univ., Wellington (New Zealand).

R. Howorth, M. J. Crozier, and I. J. Grant.

Search, Vol 12, No 1/2, p 41-43, January/February, 1981. 1 Fig, 1 Tab, 3 Ref.

Descriptors: \*Landslides, \*Tropical cyclones, \*Excess rainfall, Rainfall, Cyclones, Storms, Rainstorms, Flooding, Floods, Viti Levu, \*Fiji Islands.

As part of a slope-stability study being carried out in the Fiji Islands, landslides which occurred on Viti Levu during the time the tropical cyclone Wally passed through the area were investigated. Massive and extensive landslides occurred in the area after a rainfall exceeding 500 mm over a two-day period. The average monthly rainfall for this area is 263 mm. Severe flooding caused flood water depths of 1.0-1.5 m on the Navua River delta. Fifteen people were killed and 113 villages were affected. Times of peak discharge of the coastal rivers were coincident with the landslides. Most of the landslides occurred on the evening of April 4th. Total rainfall for April 4 was 261.8 mm, for April 3, 307.8 mm, and for April 2, 111.4 mm. Most of the slides affected only regolith, and in only one case was in situ bedrock involved. Most of the slides occurred just after nightfall, between 1800 and 2200 hr. The rain stopped at about the same time, which may have permitted the ground to regain stability. (Small-FRC)

W82-00670

### POSSIBILITY OF USING TRITIUM FOR STUDYING GLOBAL CIRCULATION OF ATMOSPHERIC MOISTURE,

Akademija Nauk SSSR, Moscow. Inst. Vodnykh Problem.

V. I. Ferronki, L. Yu. Ivanova, Kh. A. Kikichev, L. P. Kuznetsova, and V. V. Romanov.

Water Resources (English Translation), Vol. 7, No. 5, p 478-482, September/October, 1980. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 5, p 171-177, Setember/October, 1980.

Descriptors: \*Atmospheric moisture, \*Tritium, Measurement techniques, Air circulation, Isotopic tracers, Tracers, Water vapor, Atmospheric, Global circulation.

The suitability of the isotopic tracer method for use in studying global circulation of atmospheric moisture was investigated, using as a tracer the tritium ( $T$ ) produced during the low-power atmospheric nuclear in China on March 14, 1978. Tri-

tium which enters the atmosphere as a result of nuclear explosions quickly reacts with atmospheric oxygen to form the water molecular  $H_2TO$ . This tritium water vapor participates in the circulation of air masses and moisture in the atmosphere, permitting tracking of the movement of the incorporating air mass until the tritium label is removed by dispersion of air particles and moisture. The sampling method used is based on adsorption of water vapor during pumping of air through a drying agent, followed by electrolysis and measurement of the tritium concentration by a liquid scintillation spectrometer. The higher level of radioactivity in the atmosphere and precipitation permitted tracking of the radioactive cloud for two weeks after the explosion. Analysis of the movement of the labelled air mass demonstrated that the time of circulation of water vapor around the earth is a natural phenomenon as well as a theoretical concept. Under certain conditions of atmospheric circulation, packets of moisture may exist and be moved over long periods of time without substantial dispersion, at least in the stratosphere. The isotopic tracer method permits tracking of the movement of air masses and atmospheric moisture both in cloudy and rainy and in clear and dry weather. These results indicate that tritium, which can be injected at the required height by ordinary technical means, can be used as a tracer in experimental studies of global circulation of air masses and atmospheric water vapor. (Carroll-FRC)

W82-00863

### A COMPARISON OF RAINFALL-RUNOFF MODELS,

Western Australia Univ., Nedlands.

W. D. Weeks, and R. H. B. Hebert.

Nordic Hydrology, Vol 11, No 1, p 7-24, 1980. 10 Fig, 4 Tab, 16 Ref.

Descriptors: \*Rivers, \*Model studies, \*Rainfall-runoff relationships, Australia, Time series analysis, Mathematical studies, Sacramento model, Monash model, Stanford model, Boughton model, \*Comparison studies.

Five rainfall-runoff models were tested on 3 catchments in southwest Western Australia by calibration with 6 years of data followed by testing on a further 6-7 years of extra data. The Boughton Model, a simple conceptual model, was unacceptable because it was developed for catchments vastly different from the rivers studied. The Sacramento, Stanford, and Monash models, sophisticated conceptual models, and a black box or purely mathematical method involving a recursive time series algorithm all performed in a satisfactory manner. The straightforward Sacramento and the simple time series analysis are recommended for the larger rivers; the Monash and Stanford models, for the smaller catchments, Monash being marginally better. The Sacramento, with finite storages, and the time series analysis, with no provision for baseflow, performed poorly on the very small river. (Small-FRC)

W82-00911

### SIMULATION OF LAKE-WATERSHED SYSTEMS, I. DESCRIPTION AND SENSITIVITY ANALYSIS OF THE MODEL,

Alberta Univ., Edmonton. Dept. of Geology.

A. S. Crowe, and F. W. Schwartz.

Journal of Hydrology, Vol 52, No 1/2, p 71-105, June, 1981. 15 Fig, 1 Tab, 19 Ref.

Descriptors: \*Watersheds, \*Model studies, Lakes, Groundwater, Hydrology, Water quality, Salinity, Lake morphology, Precipitation, Evaporation, Surface runoff, Flow discharge, \*Lake-watershed systems.

A hydrologic transport model has been developed which is oriented primarily toward lakes and is used to examine the role that various climatic and watershed variables play in controlling the physical and chemical hydrology. The hypothetical lake-watershed system defined for the sensitivity analysis has characteristics similar to lakes in the prairie parkland of Canada. The lumped response model presented is able to simulate the hydrologic responses of a lake-watershed system to variations

## Precipitation—Group 2B

in precipitation, potential evaporation and air temperatures. It operates by routing water through an idealized system. From the use of this model several conclusions were drawn. The water level and salinities of the lake depended on the general lake morphometry. Variations in groundwater chemistry over a part of the watershed do not significantly alter the salinity of the hypothetical prairie lake. Large decreases or increases in the quality of groundwater over the entire watershed will alter the salinity of the lake. The unsaturated zone primarily controls the amount of water percolating to the groundwater zone and thus indirectly influences the amount of groundwater discharged to the lake. As the amount of a watershed covered by an unsaturated zone decreases, the amount of groundwater recharge increases. Increasing the proportion of this hypothetical watershed that is impervious causes precipitation to flow directly to the lake, decreasing salinity, increasing fluctuations of lake levels and generally increasing the lake stage. Variations in precipitation and potential evaporation do not cause large fluctuations in lake levels and salinity in the large watershed used in this analysis, but would in a small lake-watershed system. (Baker-FRC)  
W82-00926

**SIMULATION OF LAKE-WATERSHED SYSTEMS, II. APPLICATION TO BAPTISTE LAKE, ALBERTA, CANADA.**  
Alberta Univ., Edmonton. Dept. of Geology.  
A. S. Crowe, and F. W. Schwartz.  
*Journal of Hydrology*, Vol 52, No 1/2, p 107-125, June, 1981. 8 Fig, 6 Tab, 21 Ref.

Descriptors: \*Watersheds, \*Model studies, Lakes, Groundwater, Groundwater movement, Surface-groundwater relations, Lake morphology, \*Lake-watershed systems.

The applicability of a hydrologic simulation model for evaluating an actual lake-watershed system was investigated at the Baptiste Lake system in east-central Alberta, Canada. This is an important potential recreational development area, and a large data base for the area already exists. The watershed covers an area of 318 square kilometers, of which 58% is forest, 25% is standing water consisting of the subject lake, swamps and rivers, 16% is agricultural land, and less than 1% is cottage development along the lake shore. Land to the north and east of the lake is farm land, while that to the south and west is mostly swamp and forest. With the model it was possible to recapitulate a 6-year history of lake level fluctuations. The predicted and measured lake levels have a mean absolute difference of less than 0.1 meter. The cyclical character of water level fluctuations on an annual basis was also preserved in the simulation results. Although only a relatively short record of lake chemistry was available, the model was able to simulate with a reasonable degree of accuracy the total dissolved solids content of the lake. The study suggests that groundwater inflow to the lake comprises about 13% of the annual inflow from all sources and is not unreasonable for lakes in this kind of hydrological setting. (Baker-FRC)  
W82-00927

**ADAPTIVE HYDROLOGICAL FORECASTING - A REVIEW.**  
Institute of Hydrology, Wallingford (England).  
P. E. O'Connell, and R. T. Clarke.  
*Hydrological Sciences Bulletin*, Vol 26, No 2, p 179-205, June, 1981. 3 Fig, 2 Tab, 40 Ref.

Descriptors: \*Runoff forecasting, \*Rainfall, \*Mathematical models, Forecasting, Hydrology, River basins, Reviews.

A variety of models and parameter estimation algorithms for hydrological forecasting are reviewed, including a discussion of the assumptions underlying them and some problems encountered in their application. Four models were applied to 2 months of half-hourly rainfall and runoff data for the Hirnant sub-basin of the River Dee. The four models were: Model A, a version of the River Dee sub-basin model; Model B, the simple nonlinear conceptual model used by Moore and Weiss

(1980); Model C, a linear transfer function model with time variant parameters; and Model D, a selftuning predictor with PERLOG input. Models A and B had the smallest error variances, but D performed best in terms of standardized Q and S statistics. The standard assumptions of independence and identical distribution for system noise are not justified for hydrological systems. There are considerable unsolved estimation problems in real time forecasting, but it may be most beneficial to find a better representation of the spatial variation in rainfall and its effects of streamflow. (Small-FRC)  
W82-00928

#### OVERLAND FLOW ON A DIVERGING SURFACE

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.

N. Agiraloglu, and V. P. Singh.  
*Hydrological Sciences Bulletin*, Vol 26, No 2, p 137-147, June, 1981. 7 Fig, 2 Tab, 15 Ref.

Descriptors: \*Overland flow, \*Mathematical models, \*Groundwater basins, Kinetics, Hydrographs, Mathematical studies, Topography.

A basin diverging flow model is presented which utilizes kinetic wave theory. A first order explicit finite difference scheme is used to solve the kinematic equations. The model is compared with the plane model. The two models yield different concentration times and hydrographs that differ in shape, depending upon the degree of divergence. The rising hydrograph rises faster for the diverging model than for the plane model. The reverse is true for the recession hydrograph. Also, the diverging model gave longer times of concentration than the plane model. In natural basins that have divergence in their geometric configurations, the divergence model may predict hydrographs reasonably well. Suitable basins are both rural and urban with upland portions which diverge and lower portions which converge. A diverging basin's response is similar to that of a cascade of planes of decreasing size, and its discrete analog is a system composed of unequal nonlinear reservoirs used in parametric hydrology. (Small-FRC)  
W82-00926

## 2B. Precipitation

#### TRACE CONSTITUENTS IN CLOUD WATER, RAINWATER AND AEROSOL SAMPLES COLLECTED NEAR THE WEST COAST OF INDIA DURING THE SOUTHWEST MONSOON,

Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.

S. Sadasivan.  
*Atmospheric Environment*, Vol 14, No 1, p 33-38, January, 1980. 3 Fig, 3 Tab, 27 Ref.

Descriptors: \*Clouds, \*Aerosols, \*Rain, Precipitation, Seawater \*India, \*Trace levels, Halogens, Sulfates, Iodine, Bromine, Chlorides, Salts, Monsoons, Fallout, Chemical reactions.

Trace constituents were determined in cloud water, rain water, and impactor aerosol samples collected at a mountain top near the west coast of India during the summer monsoon in order to study the evolution of clouds and raindrops. Concentrations of trace constituents in cloud water were within the ranges previously reported for oceanic cloud water. Ratios of Cl, Br, and I to Na were close to those of seawater, indicating no incorporation of halogens in the cloud water. In cloud water there were excesses of Ca (probably from soil particles), K (from enrichment during transfer from seawater to air), and sulfates. Rainwater samples were difficult to analyze because the concentrations of trace constituents were near the detection limit. Average ammonium/sulfate ratio was 0.2; Cl and Na correlated well; and Br/Na and I/Na values were higher than samples from the coast taken previously. Aerosol particles collected under rainy conditions and clear weather conditions showed enrichment of Br and I at higher altitudes. These findings indicate that cloud droplets form on large and giant aerosol particles.

There is no significant gaseous I absorption in raindrops. The aerosol composition explains the observed I enrichment in rainwater. (Cassar-FRC)  
W82-00676

#### ON AUGUST MEAN TEMPERATURE AND THE SUCCEEDING SEASON'S RAINFALL OVER SOUTH AFRICA,

University of the Witwatersrand, Johannesburg (South Africa).

T. G. J. Dyer.  
*South African Journal of Science*, Vol 76, No 2, p 85-87, February, 1980. 7 Fig, 1 Ref.

Descriptors: \*Rainfall distribution, \*Temperature control, \*South Africa, Temperature, \*Seasonal distribution, Precipitation, Model studies.

The relationship between August mean temperature and the total rainfall received during the following season was investigated in light of the commonly assumed interrelationship between the two factors. The study reveals that there may be some truth in the claim of an association between August mean temperature and rainfall over part of the rainy season. The correlation fields for November and December, and also for the whole season, have areas of significant coefficients. The whole-season correlation arises, however, by virtue of the form of the fields in the former two months and to a lesser extent of that which exists during January. This is based on the fact that the fields tend to weaken in an organized fashion as the season progresses. If there is a true relationship, it is highly spatially dependent, as no correlation exists to the north of a line through Bloemfontein and Durban. Even in the strongest fields the relationship accounts for only a relatively small proportion of the total relative variance in rainfall. However, these fields lend themselves to being considered as possible inputs to any model designed to forecast seasonal rainfall. (Baker-FRC)  
W82-00692

#### A NUMERICAL COMPARISON BETWEEN LAGRANGIAN AND EULERIAN RAINFALL STATISTICS,

Stockholm Univ. (Sweden). Arrhenius Lab.  
M. Hamrud, H. Rodhe, and J. Grandell.  
*Tellus*, Vol 33, No 3, p 235-241, June, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: \*Numerical analysis, \*Precipitation, \*Comparison studies, Mathematical studies, Rainfall, Precipitation scavenging, Statistical methods.

The problem of estimating statistical parameters characterizing the precipitation experienced by a parcel of air as it is carried along by the winds is of considerable interest in connection with studies of the transport and dispersion of air pollutants subject to precipitation scavenging. Lagrangian data are data relating to the 'weather' experienced by the air parcel as it is carried along by the wind. Eulerian data are meteorological observations obtained at fixed locations. This study investigated the relationship between Lagrangian and Eulerian rainfall statistics. Parameters characterizing Lagrangian precipitation statistics were derived using 850-mbar air trajectories over northern Europe in conjunction with precipitation data. Comparisons with similar Eulerian statistics which had been spatially averaged over the area indicated that the magnitudes of these parameters differed only moderately between the two frames of reference. It therefore seems reasonable to assume as a first approximation an equality between the Lagrangian and the Eulerian estimates of the parameters studied. (Carroll-FRC)  
W82-00803

#### RELATION OF SATELLITE-BASED THUNDERSTORM INTENSITY TO RADAR-ESTIMATED RAINFALL,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.  
A. J. Negri, and R. F. Adler.

*Journal of Applied Meteorology*, Vol 20, No 3, p 388-390, March, 1981. 9 Fig, 16 Ref.

## Field 2—WATER CYCLE

### Group 2B—Precipitation

Descriptors: \*Thunderstorms, \*Satellite technology, \*Radar, \*Weather forecasting, Correlation analysis, Storms, Remote sensing.

Measurements of thunderstorm intensity determined from short-interval geosynchronous digital satellite data were compared to precipitation measurements from radar data. In the satellite infrared data, the thunderstorms were defined by the location of the relative minima in the equivalent blackbody temperature field. When the evolution of a number of storms was examined, the first low level radar echo (18dBZ) appeared when the satellite observed cloud-top minimum blackbody temperature had a mean of 245 K (7.4 km). Larger reflectivities appeared as the cloud tops penetrated upward to colder temperatures. As the storms approached and penetrated the tropopause, reflectivity values greater than 50 dBZ began. A correlation was found between satellite-based estimates of thunderstorm and maximum radar reflectivity. Thunderstorm top ascent rates in the 235-240 K region indicated the intensity of the initial storm updraft and were correlated with the maximum storm reflectivity, with weak cells having minimum reflectivity and strong cells having echos equal to or greater than 50 dBZ. (Small-FRC) W82-00806

#### APPARATUS FOR THE SIMULATION OF RAIN IN THE LABORATORY,

State Univ. of New York at Albany.

D. R. Derenzo, and B. Vonnegut.

Journal of Applied Meteorology, Vol 20, No 1, p 36-41, January, 1981. 7 Fig, 1 Tab, 15 Ref.

Descriptors: \*Rainfall simulators, \*Simulated rainfall, \*Calibrations, Rainfall, Laboratory equipment.

A method is described to produce simulated rain which does not require several meters of fall. The short fall distance means that the simulated rain can be produced without the aid of a rainshaft and within the convenience of normal ceiling height. A jet of water is directed toward the periphery of an automobile tire that rotates opposite to the flow of water. The rotating tire creates air and mechanical turbulence that break the jet up into a spray of water. Three rains having rainfall rates of 14, 48, and 2100 mm/hr were investigated using the simulator. The rains had drop-size distributions that exhibited characteristics of those found in natural rains. Also, drops fell at approximately terminal velocity. The apparatus can be used to calibrate meteorological instruments that measure some aspect of rainfall either in the field or laboratory. Examples of instruments would be those dealing with water drop-soil interactions. (Small-FRC) W82-00807

#### SATELLITE RAIN ESTIMATION IN THE U.S. HIGH PLAINS,

National Oceanic and Atmospheric Administra-

tion, Boulder, CO.

C. G. Griffith, J. A. Augustine, and W. L.

Woodley.

Journal of Applied Meteorology, Vol 20, No 1, p 53-66, January, 1981, 10 Fig, 10 Ref.

Descriptors: \*Computer models, \*Satellite technology, \*Rainfall, Arid climates, Clouds, Error analysis, Weather forecasting, High plains, Remote sensing.

A computer-automated technique to estimate rainfall using visible or infrared geosynchronous satellite imagery was used to estimate rainfall on 15 selected days in the High Plains. Each site was instrumented with a small, dense rain gauge network to provide a ground measure of rainfall for verification. Model results exceeded the corresponding gage estimates by a factor of 3-5 because the model treated convective clouds in arid regions as tropical clouds. The technique was adjusted to apply to the High Plains. Gage and satellite comparisons were made for a small area, and this comparison was extrapolated to satellite rain estimates for large areas. A second adjustment technique involved calculation of an adjustment factor using the output of a one-dimensional cumulus cloud model. Preliminary results indicated that these adjusted

techniques have considerable utility. The accuracy of the model is discussed in terms of bias, mean error factor, root mean square error, and linear regression analysis. (Small-FRC) W82-00808

#### EVALUATION OF AREAL VERSUS POINT RAINFALL WITH SPARSE DATA,

Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.

V-T-V. Nguyen, J. Rousselle, and M. B.

McPherson.

Canadian Journal of Civil Engineering, Vol 8, No 2, p 173-178, June, 1981. 10 Fig, 1 Tab, 11 Ref.

Descriptors: \*Areal precipitation, \*Rainfall distribution, \*Mathematical studies, Mathematical models, Precipitation, Hydrology, Geography, Probabilistic process, Mathematical equations, \*Urban hydrology, \*Rainfall-runoff relationships, \*Runoff forecasting.

Urban hydrologic studies designed to determine runoff peaks and volumes depend on both temporal and spatial information on rainfall distribution. Since rainfall data used as input to rainfall-runoff models are measured at a point, it is necessary to establish some relationships for the transformation of point rainfall data to areal rainfall. Mean rainfalls for a fixed area and the associated rainfall for a fixed point in that area were analyzed from a probabilistic perspective, and a theoretical methodology for establishing a relationship between these values is proposed. An exponential distribution function for hourly point rainfall was used to derive the distribution relation for mean rainfall over a fixed geographic area. Values of the areal correction factor were estimated at equal levels of exceedance probability for point and areal mean rainfalls. These estimations showed that the areal correction factor is not constant for all return periods and that its value may not always be less than or equal to 1. The point-area rainfall relationship developed by this study may be more realistic and more useful for many engineering applications because in nature the occurrence of storm centers in a given region is thought to be purely random and in engineering practice attention is often focused on a fixed area. (Carroll-FRC) W82-00835

#### ASSOCIATIONS AND MESOSCALE SPATIAL RELATIONSHIPS AMONG RAINWATER CONSTITUENTS,

Illinois State Water Survey, Urbana.

D. F. Gatz.

Journal of Geophysical Research, Vol. 85, No C10, p 5588-5598, October, 1980. 3 Fig, 13 Tab, 12 Ref.

Descriptors: \*Chemistry of precipitation, \*Deposition, \*Factor analysis, Rainwater, Mathematical studies, Precipitation, Scavenging, Metals, Heavy metals, Sulfates, Air pollution effects.

Information about how rainwater constituents are scavenged from the atmosphere and precipitated was collected in a study of 10 rain events near St. Louis during the summers of 1972-1975. Factor analysis was used to identify groups of constituents having similar deposition patterns. Rainwater samples were collected in networks of 80 or 85 open polyethylene containers and were analyzed for Li, Na, Mg, K, Ca, Fe, Zn, Cd, In, Pb, and sulfate. Four main groupings of depositional patterns occurred: soluble soil-derived elements, insoluble soil-derived elements, soluble pollutants, and insoluble pollutants. Differences between the depositional patterns of pollutants and soil elements are probably due to the distribution of sources. The differences between soluble and insoluble portions of the same element may indicate important differences in scavenging and/or precipitation formation processes. These processes need further investigation. (Small-FRC) W82-00964

#### SULFUR AND ASSOCIATED ELEMENTS AND ACIDITY IN CONTINENTAL AND MARINE RAIN FROM NORTH FLORIDA,

Florida State Univ., Tallahassee. Dept. of Oceanography.

S. Tanaka, M. Darzi, and J. W. Winchester.

Journal of Geophysical Research, Vol 85, No C8, p 4519-4526, August, 1980. 5 Fig, 4 tab, 15 Ref.

Descriptors: \*Acid rain, \*Sulfur, \*Rainfall, \*Chemical composition, Water analysis, Metals, Air pollution effects, North Florida, Baseline studies, Environmental surveys, \*Florida.

The composition characteristics of north Florida rain were investigated to establish some nonurban baselines of elemental concentrations and to estimate the extent of transport of air pollutants. A new measuring technique was used, the proton-induced X-ray emission (PIXE), which could analyze a wide range of elements from S to Pb simultaneously. Elemental composition was determined for: S, K, Ca, V, Mn, Fe, Ni, Cu, Zn, Br, Sr, and Pb, from 4 ml aliquots of 38 different rain samples. Northerly air flow rain exhibited polluted and continental characteristics. Concentrations of Pb, S, and Fe were higher, and strong correlations of Br, Ca, and Fe with Pb were found. In general, southerly air flow rain had lower elemental concentrations, and element concentrations were not correlated with Pb. The average pH of northern rain was 4.4, while southern rain had an average pH of 5.3. The region of influence for atmospheric pollution industrial regions seemed larger than is usually thought. (Small-FRC) W82-00965

#### THE MAGNITUDE OF THE HYDROLOGICAL FREQUENCY FACTOR IN MAXIMUM RAINFALL ESTIMATION,

Science and Education, Beltsville, MD. Hydrol-

ogy.

D. M. Hershfield.

Hydrological Sciences Bulletin, Vol 26, No 2, p 171-177, June, 1981. 5 Fig, 1 Tab, 7 Ref.

Descriptors: \*Rainfall, \*Probable maximum precipitation, \*Frequency analysis, Precipitation, Probability distribution, Mathematical studies, \*Eastern United States.

Results from several sets of maximum rainfall data are compared and related in terms of a frequency factor. Chow's hydrological frequency factor is used, which is primarily a function of the recurrence interval for a particular probability distribution. This frequency factor is displayed as a function of the mean of the annual maxima for both official and unofficial rainfall observations and the probable maximum precipitation. The frequency factor is shown to be a function of the magnitude of the unofficial rainfall observations and probable maximum precipitation for areas in the eastern U.S. This suggests that the magnitude of probable maximum precipitation is largely influenced by the magnitude of the frequency factor. The geographic distribution of the probable maximum distribution factor was displayed on maps for the eastern United States, and ranged from about 20 in the south to more than 35 in the north. (Small-FRC) W82-00983

#### NUMERICAL SIMULATION OF THE EFFECTS OF COOLING TOWER COMPLEXES ON CLOUDS AND SEVERE STORMS,

South Dakota School of Mines and Technology, Rapid City.

H. D. Orville, P. A. Eckhoff, J. E. Peak, J. H.

Hirsch, and F. J. Kopp.

Atmospheric Environment, Vol 15, No 5, p 823-836, 1981. 12 Fig, 1 Tab, 24 Ref.

Descriptors: \*Cooling towers, \*Storms, Rainstorms, Hail, Rain, \*Temperature effects, Simulation analysis, Mathematical studies, Model studies, \*Powerplants, Heat, Clouds, Latent heat, Sensible heat.

Attempts were made to determine the effects of excess heat and vapor from large power parks on heavy rain and hailstorms through the use of numerical simulation studies. A two-dimensional, time-dependent model was used which gave realistic simulations of many severe storm processes

## WATER CYCLE—Field 2

### Evaporation and Transpiration—Group 2D

including heavy rains, hail and strong winds. The model is a set of partial differential equations which describe time changes of momentum, energy, and mass. Appropriate boundary and initial conditions are imposed on a domain about 20 km high by 20 km wide and 200 meter grid intervals to complete the model. Modifications were made to allow additional water vapor and heat to be added at several lower grid points to simulate effluents from a power peak. Realistic storm situations were recreated. One atmospheric sounding has a strong middle-level inversion which tends to inhibit the first convective clouds but later gives rise to a severe storm with hail and heavy rains. One other sounding is taken from a day in which a severe storm occurred in the Miami area. A third sounding depicts atmospheric conditions in which severe storms formed in the vicinity of Huron, South Dakota. Results of the study indicate that a power park emitting 80% latent heat and 20% sensible heat has little effect on the simulated storm. A case with 100% sensible heat emission leads to a much different solution, with the simulated storm reduced in severity and the rain and hail redistributed. A case in which water vapor is accumulated in a region and released over a broad depth results in slightly more rain from a severe storm. (Baker-FRC)

W82-00995

**ATMOSPHERIC WATER CONTENT OVER THE TROPICAL PACIFIC DERIVED FROM THE NIMBUS-6 SCANNING MICROWAVE SPECTROMETER,**  
National Environmental Satellite Service, Washington, DC.  
For primary bibliographic entry see Field 7B.

W82-01004

**VARIATIONS IN PRECIPITATION PARAMETERS BETWEEN DROUGHT AND NON-DROUGHT PERIODS IN TEXAS AND SOME IMPLICATIONS FOR CLOUD SEEDING,**  
National Weather Service, Stoneville, MS.

M. S. Flynn, and J. F. Griffiths.

Journal of Applied Meteorology, Vol 19, No 12, p 1363-1370, December, 1980. 1 Fig, 6 Tab, 3 Ref.

Descriptors: \*Drought, \*Cloud seeding, Weather modification, Moisture deficiency, Water shortage, Water deficit, Artificial precipitation, Rainfall, Irrigation practices, \*Texas.

Information concerning rainfall patterns over Texas was extracted from the Texas Section of Hourly Precipitation Data of the US Weather Bureau, 1950-1973. The data involved a study of hourly rainfall for the period of time used for the current study, 1950-1969. Twelve key sites were selected for the evaluation. No easily identifiable patterns for regions emerged from the analysis of the data, which may indicate that many more than 12 sites should be included in future studies. Based on these stations, however, severe droughts in Texas appeared to be characterized by a reduction in both the number of individual rainfalls experienced and a reduction in the intensity of the falls. This indicates that days of cloud seeding opportunity as well as natural precipitation efficiency are diminished, and attempts to start rainfall by artificial methods may have limited success. Length of rainfall during severe droughts is also diminished significantly, and therefore there would be little opportunity for seeding clouds already producing rain. It is also suggested that there is a little benefit to be gained by shutting down irrigation equipment once a rain has started during a severe drought. (Baker-FRC)

W82-01006

## 2C. Snow, Ice, and Frost

### PHYSICAL MECHANICS OF AUFÉIS GROWTH,

Alaska Univ., Fairbanks Inst. of Water Resources.

D. L. Kane.

Canadian Journal of Civil Engineering, Vol 8, No 2, p 186-195, June, 1981. 9 Fig, 21 Ref.

Descriptors: \*Auféis, \*Freezing, \*Arctic, Polar regions, \*Ice formation, Physical properties, River mechanics, Pore pressure, Water pressure, Groundwater, Permafrost, Frozen ground, Piezometers, Time series analysis, Mathematical studies, Alaska.

Although subsurface physical systems in arctic and subarctic regions are frequently considered to be dormant during the winter months, several heat and mass transfer processes near the surface are quite active. These include auféis growth, which occurs when water under pressure in a stream channel flows onto the existing ice cover and freezes. Data relating to the process of auféis growth were collected on two small watersheds near Fairbanks, Alaska, over several winters. The pressure variations of the fluid in the porous streambed were measured using piezometers installed at several sites. Time series analyses were used to correlate the variations in the observed pore pressures with climatic variables. The piezometer measurements of pore water pressure indicated that subpermafrost groundwater or groundwater from nonpermafrost regions was the source of water for these ice deposits. Groundwater pore pressures were found to be sufficient to vertically lift the soil overburden and ice in the vicinity of the stream if an impermeable barrier existed. Ice lenses, formed when the seasonal frost penetrated to a zone high in soil moisture, provided this barrier. Ice wedges were found to develop in the seasonal frost zone near the water table, and the thickness of this ice wedge decreased with increasing distance from the stream. Time series analysis of air temperature and groundwater pore pressure indicated that periods of auféis growth would be associated with or follow periods of moderately warm weather. Although the raw data for the later winter months supported this conclusion, it was less evident in the early winter months. A time lag was also found to exist between the start of a warming trend and the corresponding increase in pore water pressure, and this time lag increased with increasing ice thickness. (Carroll-FRC)

W82-00836

**OCCURRENCE OF ICE LAYERS AT THE BASE OF HIGH ARCTIC SNOWPACKS,**  
McMaster Univ., Hamilton (Ontario). Dept. of Geography.

M.-K. Woo, and R. Heron.

Arctic and Alpine Research, Vol. 13, No. 2, p 225-230, May 1981. 3 Fig, 1 Tab, 6 Ref.

Descriptors: \*Snowpack, \*Ice formation, Cold regions, \*Arctic zone, Snowmelt, Melting, Interfaces, \*Canada, Cornwallis Island.

Field observations were carried out near Resolute, Cornwallis Island, North West Territory, during the snowmelt periods of 1979 and 1980 at sites underlain by gravel, bog, and lake ice which was frozen to the lake bottom. At each site, snow temperatures and temperatures at various depths in the ground or in the lake ice were measured using thermistors. The measurements suggest two stages in the formation of a basal ice layer in most High Arctic snowpacks, including seepage of the meltwater into the frozen substrate before the ice is formed and initiation and sustained growth of a basal ice layer. Each stage of development seems to be affected by a set of conditions which can terminate further ice growth. At the seepage stage, the amount of meltwater lost to the substrate depends on the nature of the frozen material and the amount of ice already frozen in its pores. Seepage loss to lake ice is negligible because of its low permeability, but the ample pore space in coarse gravel will permit substantial seepage, and basal ice layer formation may be retarded. When most pores in the frozen substrate are sealed, further supplies from the pack will freeze as a basal ice layer if the substrate is sufficiently cold to dissipate the latent heat. With warming, however, additional meltwater will slush the snow above the ice layer, or will move downslope along the ice surface. A collection of lateral drainage sometimes produces thick ice layers in topographic depressions, as long as the ground temperature remains below zero degrees centigrade for an extended time. (Baker-FRC)

W82-00844

THE EFFECTS OF SURFACE DUST ON SNOWMELT RATES,  
McMaster Univ., Hamilton (Ontario). Dept. of Geography.

J. J. Drake.

Arctic and Alpine Research, Vol. 13, No 2, p 219-223, May, 1981. 1 Fig, 14 Ref.

Descriptors: \*Snowmelt, \*Dusts, Wind velocity, solar radiation, Mathematical studies, Mathematical models, Temperature effects, Snowpack.

A basic assessment is presented of both the albedo and other effects of surface dust on snowmelt rates. These effects are illustrated with a particular numerical example from Schefferville. A model is presented which demonstrates the changes in albedo and surface temperature in relation to dust cover. This model leads to realistic order-of-magnitude estimates of the conditions under which snowmelt will be advanced or retarded. Thick dust covers, low solar radiation and high windspeeds retard snowmelt, while thin dust covers, intense solar radiation and low windspeeds increase snowmelt rates. The results agree with an earlier observation that dust covered snow near active mine sites is completely melted some four days before the general snowpack in the area. Other experiments have demonstrated that Mount St. Helens ash retarded melt at thickness greater than 10 to 20 mm. (Baker-FRC)

W82-00845

**THE DISTRIBUTION OF SEA ICE MELTWATER IN THE EASTERN CANADIAN ARCTIC,**  
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.

F. C. Tan, and P. M. Strain.

Journal of Geophysical Research, Vol 85, No C4, p 1925-1932, April, 1980. 11 Fig, 3 Tab, 24 Ref.

Descriptors: \*Isotopic tracers, \*Sea ice, Snowmelt, \*Arctic zone, Isotope studies, Salinity, \*Baffin Bay, \*Canada, Melt water.

The feasibility of using oxygen isotope techniques to study the formation of Baffin Bay (eastern Canadian Arctic) bottom water was investigated. Water samples and sea ice cores were collected and analyzed to determine the oxygen isotopic composition. The nature of freezing seawater is such that sea ice contains much less salt than the water from which it was formed but does not have a very different isotopic composition. The distribution of sea ice melt water in the area was determined. Results indicated that the proposal by Sverdrup et al. which suggests that this water mass is a mixture of Labrador Sea deep water and Baffin Bay surface water may be true. The analysis also gave support to the formation mechanism proposed by Collin and Bailey. Greater than 250-m water in Nares Strait (Smith Sound) had the same isotopic composition as both Baffin Bay deep water and bottom water. The difference in salinity between the Nares Strait water and the bottom water could be due to the addition of brines during ice formation. (Small-FRC)

W82-00966

## 2D. Evaporation and Transpiration

**TRANSPIRATION, STOMATAL CONDUCTANCE, AND PHOTOSYNTHESIS OF TOMATO PLANTS WITH VARIOUS PROPORTIONS OF ROOT SYSTEM SUPPLIED WITH WATER,**  
Department of Agriculture, Harrow (Ontario).

For primary bibliographic entry see Field 21.

W82-00504

**SEASONAL CHANGES IN LEAF AREA, STOMATAL AND CANOPY CONDUCTANCES AND TRANSPIRATION FROM BRACKEN BELOW A FOREST CANOPY,**  
Institute of Hydrology, Wallingford (England).

J. Roberts, C. F. Pymar, J. S. Wallace, and R. M. Pitman.

Journal of Applied Ecology, Vol 17, No 2, p 409-422, August, 1980. 5 Fig, 3 Tab, 22 Ref.

## Field 2—WATER CYCLE

### Group 2D—Evaporation and Transpiration

Descriptors: \*Stomatal transpiration, \*Forests, \*Canopy, Leaves, Conductance, Pine trees, Trees, Evapotranspiration, Seasonal variation, Water consumption.

The use of water by forests depends both on the major tree species present and on the amount and type of undercover. Therefore, in studying the factors controlling evaporation from a Scots pine forest at Thetford Chase, East Anglia, it was necessary to estimate the contribution from the bracken undergrowth. The development of the bracken canopy beneath the forest was investigated and the values of stomatal and canopy conductances were obtained for use in calculating bracken transpiration. Transpiration from the bracken was calculated using leaf area index and stomatal conductance values and appropriate environmental variables in the Penman-Monteith Equation. Calculated transpiration agreed well with independent values derived by weighing transplanted bracken. The contribution of bracken to the total forest transpiration was over 50% when the soil was driest and the atmospheric humidity deficits were also high. Under normal summer conditions, the bracken underbrush contributed between 20 and 25% of the total forest transpiration. Bracken stomatal conductance appears to be largely insensitive to atmospheric humidity deficits or to soil moisture conditions in forest environments. (Carroll-FRC) W82-00655

**CONSUMPTIVE USE AND DAILY EVAPOTRANSPIRATION OF CORN UNDER DIFFERENT LEVELS OF NITROGEN AND MOISTURE REGIMES,**  
Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Agronomy.  
M. Devender Reddy, I. Krishna Murthy, K. Anand Reddy, and A. Venkatachari.  
Plant and Soil, Vol 56, No 1, p 143-147, 1980. 3 Fig. 6 Ref.

Descriptors: \*Corn, \*Evapotranspiration, \*Consumptive use, Water use, Nitrogen, Crop yield, Semiarid lands, Fertilization, Soil water, \*India, Soil-water-plant relationships.

Cropping of corn in the semi-arid regions of Andhra Pradesh, India, was investigated by determining corn's seasonal consumptive use, daily evapotranspiration, and water use under different levels of nitrogen and moisture regimes. Consumptive use difference was less among different nitrogen levels, but was marked between different moisture regimes. Evapotranspiration was less in the initial stages of the growing season, attained a peak at 80% of the growing season, and declined at the end of the season when maturity was reached. As nitrogen levels increased up to 180 kg N/ha, water use efficiency increased. There was a close relationship between the continuous availability of soil moisture and the response of corn to fertilizer application. If soil moisture becomes a limiting factor, the addition of fertilizer at this time might adversely affect the yield. Among moisture regimes, higher water use efficiency was found under 20% available soil moisture depletion. (Small-FRC) W82-00660

**THE INFLUENCE OF PLANT COMMUNITIES UPON THE HYDROLOGY OF CATCHMENTS,**  
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.  
J. W. Holmes, and E. B. Wronski.  
Agricultural Water Management, Vol 4, No 1-3, p 19-34, 1981. 2 Fig, 8 Tab, 27 Ref.

Descriptors: \*Catchment areas, \*Vegetation effects, \*Evapotranspiration, \*Forest watersheds, Evaporation rate, Leaves, Runoff, Groundwater recharge, Hydrology, \*Australia.

The effect of land use on the water yield from catchments is reviewed, with emphasis on forested land. In general, less runoff occurs on forested catchments because the evapotranspiration from them is larger than from catchments not in forest. Rainwater held upon wet foliage evaporates faster than the transpiration rate would be if the leaves

were dry. Interception loss may account for the observed yields from forested catchments, up to 200 mm/yr less than, for example, grassland. The interception store can be 2 mm. Also, deep-rooted perennial plants created a soil-water deficit that is probably larger than that caused by annual pasture or cereal crops. The data available indicate that it is probable that a soil-water deficit of 250 mm each year could be created by an evergreen forest and 180 mm each year by annuals. This is valid for the climatic regions of southern Australia, where rainfall is 700 mm/year or more. This implies a yield of 70 mm/year less from forested land in runoff or recharge of groundwater. Thus, a forested area will experience enhanced evaporation of rainwater on leaves, and this may eventually cause hydrologic changes. (Small-FRC) W82-00931

**LEAF AND ENVIRONMENTAL PARAMETERS INFLUENCING TRANSPERSION: THEORY AND FIELD MEASUREMENTS,**  
Wyoming Univ., Laramie. Dept. of Botany.  
W. K. Smith, and G. N. Geller.  
*Oecologia*, Vol 46, No 3, p 308-313, September, 1980. 3 Fig, 1 Tab, 21 Ref.

Descriptors: \*Desert plants, \*Leaves, \*Transpiration, Xerophytes, Stomatal transpiration, Soil-water-plant relationships.

This paper investigated the influence of changes in leaf size or wind on transpiration at a given stomatal resistance for various combinations of air temperature and absorbed solar energy. Predicted transpiration either increased or decreased for increases in leaf size depending on the specific combinations of the above factors. Major reductions in simulated transpiration with increasing leaf size occurred for shaded, highly reflective, or specially oriented leaves (fraction of full sunlight, 0.1) at relatively high air temperatures when stomatal resistance was below 500 s per m. Increases in fraction of sunlight (to 0.7) and decreases in air temperature (to 20°C) lowered this critical resistance to below 50 s per m. When stomatal resistance was above this critical value of 500 s per m, transpiration increased with larger leaves and less wind. The theoretical results were compared to field measurements on some desert plants. (Cassar-FRC) W82-00979

**SOIL MOISTURE RELATIONS IN THE SOUTHERN CALIFORNIA CHAPARRAL,**  
San Diego State Univ., CA. Dept. of Biology.  
E. Ng, and P. C. Miller.  
*Ecology*, Vol 61, No 1, p 98-107, 1980. 6 Fig, 3 Tab, 53 Ref.

Descriptors: \*Soil moisture, \*Chaparral, \*California, Drought, Moisture availability, Transpiration, Vegetation regrowth, \*Soil-water-plant relationships.

Soil moisture balance and vegetation studies were conducted on two chaparral-covered slopes in southern California. Vegetation on the north-facing slope was dominated by *Ceanothus greggii*, and on the south-facing slope by *Adenostoma fasciculatum*. Vegetation cover on the north-facing slope was greater than on the south-facing slope. Throughout the year, soil moisture at 0.3-1.0 m depths was greater on the south-facing slope than on the north-facing slope. Soil texture on the two slopes did not differ significantly. Precipitation on the two slopes was the same, averaging 30 cm/year, below the usual level for this area. Subsurface drainage was greater on the south-facing slope and peaked in January, close to the time of maximum precipitation. Evaporation was greater on the south-facing slope, but transpiration was greater on the north-facing slope. The greater vegetation cover and drier soils on the north-facing slope are probably related to the drought-resistant nature of vegetation in this mediterranean climate. The greater transpiration on the north-facing slope is probably due to the ability of the plants on this slope to draw water from deeper soil layers and to maintain open stomata at lower water potentials. (Baker-FRC) W82-01035

**RATIO BETWEEN EVAPOTRANSPIRATION OF IRRIGATED CROPS FROM FLOATING LYSIMETERS AND CLASS A PAN EVAPORATION,**  
Department of Agriculture, Harrow (Ontario). Research Station.

C. S. Tan, and J. M. Fulton.  
*Canadian Journal of Plant Science*, Vol 60, No 1, p 197-201, January, 1980. 3 Fig, 8 Ref.

Descriptors: \*Evapotranspiration, \*Vegetation effects, Evapotranspiration potential, Lysimeters, Evaporation rate, Evaporation pans, Evaporimeters, Water loss, Potatoes, Corn, Tomatoes, \*Irrigation, \*Vegetable crops, \*Ontario, Canada.

This paper provides the crop coefficient of early potatoes, corn and processing tomatoes using evapotranspiration data on irrigated crops collected from floating lysimeters and potential crop evapotranspiration obtained from Class A pan at Harrow for the growing season of 1963 through 1972. The crop coefficient is the ratio of crop evapotranspiration to potential or maximum evapotranspiration. The value of the crop coefficient depends on the percentage of foliage cover on the soil, increasing from emergence to about 50-80% of foliage cover, remaining at a maximum value for about 2-5 weeks, and thereafter decreasing during the late season stage until the crops approach maturity. The low value of the crop coefficient at the initial stage of crop development may be attributable to the evaporation rate from bare soil. The soil evaporation can be affected by irrigation and rainfall frequency. As the soil surface water dries out, though the root zone water is ample, the value of the crop coefficient will remain at a low value. This is because the capillary flow from the root zone of the soil body to the soil surface limits the rate of evaporation. As the percentage of foliage cover continues to increase, the evaporation from soil becomes less important and remains relatively constant. (Baker-FRC) W82-01050

### 2E. Streamflow and Runoff

**A LEAKY RESERVOIR MODEL FOR EPHEMERAL FLOW RECESSION,**  
Office of Surface Mining Reclamation and Enforcement (DOI), Washington, DC.  
R. W. Peebles, R. E. Smith, and S. J. Yakowitz.  
*Water Resources Research*, Vol 17, No 3, p 628-636, June, 1981. 9 Fig, 1 Tab, 12 Ref.

Descriptors: \*Ephemeral streams, \*Recession, \*Streamflow forecasting, Reservoirs, Storage, Flood flow, Flood peak, \*Model studies, Hydrographs, Infiltration, Reservoir leakage, \*Streamflow depletion.

A leaky reservoir model is proposed to represent streamflow recession in an ephemeral stream. The model is described by a continuity equation, a discharge-stage relation (stream rating), and a stage-storage relation (reservoir configuration). The infiltration loss in the stream channel is analogous to leaking in the bottom of a reservoir. No input is routed through the reservoir; at the onset of the recession the reservoir has water in storage. By calibrating reservoir leakage rate and initial storage (reservoir shape) a good fit to observed curves is obtained. The most critical parameter is reservoir shape; recession curves do not change much with changing reservoir loss rate. (Cassar-FRC) W82-00600

**MULTIVARIATE HYDROLOGIC TIME SERIES ANALYSIS,**  
Ottawa Univ. (Ontario). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2A. W82-00647

**EFFECTS OF RECENT INCREASES IN RAINFALL ON FLOODS AND RUNOFF IN THE UPPER HUNTER VALLEY,**

## WATER CYCLE—Field 2

### Groundwater—Group 2F

New South Wales Univ., Kensington (Australia). School of Geography. F. C. Bell, and W. D. Erskine. Search, Vol 12, No 3/4, p 82-83, March/April, 1981. 2 Fig, 1 Tab, 8 Ref.

Descriptors: \*Runoff, \*Flood frequency, Channel improvement, \*Rainfall-runoff relationships, \*Hunter Valley, \*Australia, Streamflow, Water resources development.

Recent large and significant changes in flood frequencies and annual runoff were observed since 1946 in the Hunter Valley, Australia. Results of analysis of rainfall and runoff records since 1898 suggest that the cause is the increased rainfall and lower frequency of dry years after 1946, not catchment modifications or disturbance. Before 1946, channel and catchment modifications probably caused decreases in runoff and runoff variability during dry years and increases during wet years. After 1946 there was no effect from modification activities. (Cassar-FRC)  
W82-00668

**EFFECTS OF TROPICAL CYCLONE WALLY IN SOUTHEAST VITI LEVU, FIJI, EASTER 1980,**  
Victoria Univ., Wellington (New Zealand). For primary bibliographic entry see Field 2A.  
W82-00670

**FLOODS IN KANSAS CITY, MISSOURI AND KANSAS, SEPTEMBER 12-13,**  
Geological Survey, Rolla, Mo. Water Resources Div.  
L. D. Hauth, W. J. Carswell, Jr., and E. H. Chin. Branch of Dist., USGS 604 South Pickett St. Alexandria, Va. 22304. Price \$3.50. Geological Survey Professional Paper 1169, 1981. 47 p, 39 Fig, 4 Tab, 21 Ref.

Descriptors: \*Floods, \*Flood data, \*Flood damage, \*Flood peak, \*Flood profiles, Gaging stations, Flood flow, Streamflow, Rainfall-runoff relationships, Flood frequency, Hydrologic data, Flood hydrographs, \*Missouri, \*Kansas, \*Kansas City.

The storms of Sept. 12-13, 1977, delivered as much as 16 in. of rain, with average rainfall exceeding 10 in. in the Kansas City metropolitan area. Twenty-five lives were lost, many were left homeless, and damages exceeded \$80 million. Data obtained by the National Weather Service and the U.S. Geological Survey indicate that two record-setting rainstorms occurred within 24 hours. The first storm, in the early morning, thoroughly soaked the local drainage basins. The second storm, centered along the Brush and Round Grove Creek basins, resulted in a devastating flash flood. Peak discharges were determined during and after this major flood at gaging stations and selected miscellaneous locations. Streamflows and flood volumes in many locations far exceeded estimated values for the 100-year flood. (USGS)  
W82-00724

**TEMPERATURE AND SOLUTE-TRANSPORT SIMULATION IN STREAMFLOW USING A LAGRANGIAN REFERENCE FRAME,**  
Geological Survey, NSTL Station, MS. Water Resources Div.  
H. E. Jobson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-225757, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-2, 1980. 165 p, 21 Fig, 2 Tab, 24 Refs.

Descriptors: \*Computer models, \*Temperature, \*Solute transport, \*Streamflow, Path of pollutants, Tracking techniques, Traveltime, Rivers, Flow, Unsteady flow, Open channels, Numerical analysis, Mathematical models, Prediction, Computer programs.

A computer program for simulating one-dimensional, unsteady temperature and solute transport in a river has been developed and documented for

general use. The solution approach to the convective-diffusion equation uses a moving reference frame (Lagrangian) which greatly simplifies the mathematics of the solution procedure and dramatically reduces errors caused by numerical dispersion. The model documentation is presented as a series of four programs of increasing complexity. The conservative transport model can be used to route a single conservative substance. The simplified temperature model is used to predict water temperature in rivers when only temperature and windspeed data are available. The complete temperature model is highly accurate but requires rather complete meteorological data. Finally, the 10-parameter model can be used to route as many as 10 interacting constituents through a river reach. (USGS)  
W82-00726

#### THE ROLE OF SUBSTRATUM IN BENTHIC MACROINVERTEBRATE MICRODISTRIBUTION AND LITTER DECOMPOSITION IN A WOODLAND STREAM,

North Carolina Univ. at Chapel Hill. Dept. of Zoology.  
S. R. Reice. Ecology, Vol 61, No 3, p 580-590, 1980. 4 Fig, 5 Tab, 38 Ref.

Descriptors: \*Ecosystems, \*Streams, Litter, Organic matter, \*Leaves, \*Decomposition, Decomposing organic matter, Detritus, \*Macroinvertebrates, Spatial distribution, \*Substrates, New Hope Creek, Orange County, \*North Carolina, Forest watersheds.

The contribution of substratum per se on decomposition of leaf litter and microdistribution of benthic invertebrates in streams were investigated. The study was conducted in winter 1975-76 in New Hope Creek, Orange County, North Carolina. The site was Duke Forest, which affords a protected habitat. The substratum was relatively uniform, consisting of cobbles with a few boulders, some sand, and gravel. Overall litter decomposition did not vary among substrata. The fraction of animal populations in leaf packs was proportional to the biomass remaining. Animals showed substratum preferences even when velocity differences were eliminated. Preferences of common taxa were unaffected by the presence or absence of leaf packs on the substratum. Common taxa showed strong preferences for either leaves or substrata. Abundance data strongly contradict the density data. The latter measure offers more biological insight. These results emphasize the importance of substratum size as a prime determinant of the structure of lotic macroinvertebrate communities. (Baker-FRC)  
W82-01027

**FLOW ANALYSIS OF MODELS OF THE HUBBARD BROOK ECOSYSTEM,**  
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.

For primary bibliographic entry see Field 1A.  
W82-01038

## 2F. Groundwater

#### HYDROGEOLOGICAL AND GEOPHYSICAL LOGGING.

Wuidart Engineering Ltd., Shefford Beds (England).

For primary bibliographic entry see Field 7B.  
W82-00511

**THE USE OF NA/CL RATIOS TO TRACE SOLUTE SOURCES IN A SEMIARID ZONE,**  
Weizmann Inst. of Science, Rehovot (Israel). Isotope Dept.

For primary bibliographic entry see Field 7B.  
W82-00601

**A MATHEMATICAL MODEL FOR CONSOLIDATION IN A THERMOELASTIC AQUIFER DUE TO HOT WATER INJECTION OR PUMPING,**

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.  
J. Bear, and M. Y. Corapcioglu. Water Resources Research, Vol 17, No 3, p 723-736, June, 1981. 1 Fig, 30 Ref.

Descriptors: \*Subsidence, \*Geothermal studies, Aquifer management, \*Mathematical models, Model studies, \*Thermal water, \*Injection wells, Wells, Pore pressure, Energy, Storage.

This paper develops a mathematical model to estimate fluid pressure, temperature, land subsidence and horizontal displacement produced by hot water injection into thermoelastic confined and leaky aquifers (for energy storage), pumping from a geothermal field, or flooding a warm aquifer with cold water. Assuming that the aquifer is thin relative to the horizontal distances involved, the dependent variables are average (over the aquifer thickness) values. The solid matrix is assumed to be thermoelastic. After development of three-dimensional conservation of mass and energy equations and equilibrium equations in terms of horizontal and vertical displacements, the model is derived by averaging the three-dimensional model over the vertical thickness of the aquifer, subject to conditions of plane total stress. The resulting averaged coupled equations are stated in terms of pore water pressure, temperature, and vertical and horizontal displacement. An example of a single pumping/injection well is given as an illustration. (Cassar-FRC)  
W82-00602

**DETERMINATION OF HYDROGEOLOGICAL PARAMETERS USING SINUSOIDAL PRESSURE TESTS: A THEORETICAL APPRAISAL,**  
Institute of Geological Sciences, Harwell (England). Environmental Protection Unit.

For primary bibliographic entry see Field 7B.  
W82-00603

**A NON-EQUILIBRIUM THERMODYNAMICS APPROACH TO TRANSPORT PHENOMENA IN CAPILLARY POROUS MEDIA,**  
Universidade Federal de Vicosa (Brazil). M. Fortes, and M. R. Okos. Transactions of the ASAE, Vol 24, No 3, p 756-760, May/June, 1981. 41 Ref.

Descriptors: Porosity, Thermodynamics, \*Model studies, \*Groundwater movement, Mathematical studies, Capillary water, \*Porous media, Soil water, Capillary conductivity.

The objective of this work is to present a set of transport equations which incorporates most of the existing models by combining the mechanistic and irreversible thermodynamics approaches to heat and mass transfer in porous media. A comparison between the non-equilibrium thermodynamics equations and those obtained from a mechanistic reasoning leads to the evaluation of the phenomenological coefficients. DuFour and Soret's coefficients are obtained from Onsager's relationships. The model describes transport phenomena in capillary-porous media. It is shown based on the local equilibrium principle, that the isothermal driving force for both liquid and vapor transfer in a porous medium is the gradient of equilibrium moisture content. Thus, it is postulated that water, in a capillary-porous medium, can move in opposition to a moisture content gradient, but always in the direction of the equilibrium moisture content gradient. (Baker-FRC)  
W82-00697

**HYDROGEOCHEMISTRY AND SIMULATED SOLUTE TRANSPORT, PICEANCE BASIN, NORTHWESTERN COLORADO,**  
Geological Survey, Lakewood, CO. Water Resources Div.  
For primary bibliographic entry see Field 5B.  
W82-00723

**POTENSIOMETRIC-SURFACE MAP FOR THE CRETACEOUS AQUIFER, VIRGINIA COASTAL PLAIN, 1978,**

## Field 2—WATER CYCLE

### Group 2F—Groundwater

Geological Survey, Richmond, VA. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W82-00727

POTENIOMETRIC SURFACE OF THE WILCOX-CARRIZO AQUIFER; BIENVILLE, RED RIVER, NORTHERN NATCHITOCHES, AND SOUTHERN WEBSTER PARISHES, LOUISIANA,  
Geological Survey, Alexandria, LA. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W82-00728

GENERALIZED THICKNESS OF THE FLORIDA AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,  
Geological Survey, Tallahassee, FL. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W82-00729

APPROXIMATE GROUND-WATER-LEVEL CONTOURS, APRIL 1981, FOR THE SOQUEL-APTO AREA, SANTA CRUZ COUNTY, CALIFORNIA,  
Geological Survey, Menlo Park, CA. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W82-00734

RESISTIVITY STUDY OF A COASTAL KARST TERRAIN, FLORIDA,  
Geological Survey, Tampa, FL.  
J. D. Fretwell, and M. T. Stewart.  
Ground Water, Vol 19, No 2, p 156-162, March/April, 1981. 6 Fig, 1 Tab, 24 Ref.

Descriptors: \*Resistivity, \*Saline-freshwater interfaces, \*Coastal aquifers, Aquifer properties, Geohydrology, Electrical properties, \*Karst hydrology, \*Florida, Saline water intrusion.

Results from the resistivity method for locating a fresh-salt water interface agreed with known hydrologic data. The study site was the west-central Gulf coast area of Florida, where 28 vertical electrical soundings were done. Four geoelectric layers were revealed: surficial sands; a karstic, highly transmissive carbonate; a less porous carbonate; and a saline carbonate layer with resistivity of less than 1 ohm-meter. The depth of the fresh-salt water interface decreased toward the coast.  
(Cassar-FRC)  
W82-00817

NUMERICAL SIMULATION OF POTENIOMETRIC SURFACE CHANGES CAUSED BY A PROPOSED OPEN-PIT ANTHRACITE MINE, Stone and Webster Engineering Corp., Cherry Hill, NJ.  
For primary bibliographic entry see Field 6A.  
W82-00819

THE DEVELOPMENT OF METHODS FOR DETERMINING AQUIFER CHARACTERISTICS, Ohio State Univ., Columbus.  
R. Broadhead.  
Ground Water, Vol 19, No 2, p 230-232, March/April, 1981. 1 Fig, 33 Ref.

Descriptors: \*Aquifer characteristics, \*Mathematical studies, \*Storage coefficient, \*Transmissivity, Aquifers, Groundwater reservoirs, Groundwater availability.

Recent effects in refining mathematical techniques to describe aquifer characteristics are summarized. Ground water hydrologists are primarily concerned with the storage coefficient ( $S$ ) and the coefficient of transmissivity ( $T$ ). The latest advance is the work by Rushton, presented in 1978. A mathematical model was developed to estimate transmissivity and the storage coefficient from pumped well data only. In 1971 Nawrocki experimentally compared four methods of determining  $T$

and  $S$ . No method was found to yield consistently higher or lower results than the others. The sensitivity of the various equations to the accuracy of the data input had not been determined. The major factor limiting the accuracy of aquifer coefficients is the inhomogeneity of real aquifers. In the future, a good appreciation for the inherent variations in the coefficients should be combined with an awareness of the final use intended for the coefficients.  
(Small-FRC)  
W82-00827

#### PREDICTIVE DEPOSITIONAL MODEL FOR GLACIAL AQUIFERS,

University of South Florida, Tampa. Dept. of Geology.

M. T. Stewart.

Ground Water, Vol 19, No 2, p 133-137, March/April, 1981. 10 Fig, 1 Tab, 7 Ref.

Descriptors: \*Groundwater mining, \*Mathematical models, \*Glacial aquifers, Aquifers, Glaciers, Bedrock, \*Wisconsin, Groundwater potential.

This study defined zones within valley fill in northeastern Wisconsin that have a high probability of containing high-yield drift aquifers. A depositional model was developed to aid in the location of high-yield drift aquifers. The yield and spatial distribution of glacial aquifers were controlled by bedrock topography and glacial geology. Driller's logs were used to obtain lithologic control for identification and classification of aquifer units. This information was combined with seismic reflection and gravity survey data to derive the bedrock elevation map. Bedrock topography strongly influenced the distribution and character of glacial units and clearly delineated two glacial aquifer types: valley and morainal units. Valley aquifers are the most productive. Using statistical analysis, a model was developed which allows the knowledge of bedrock topography to be coupled with glacial geology to predict the spatial distribution of glacial aquifers.  
(Small-FRC)  
W82-00828

THE RELATIONSHIP BETWEEN FRACTURE TRACES AND JOINTS IN A TERTIARY BASIN, SOUTHWEST MONTANA, Indiana Univ. at Bloomington. Dept. of Geology.  
For primary bibliographic entry see Field 7B.  
W82-00829

WASTE HEAT BALANCE IN AQUIFERS CALCULATED BY A COMPUTER PROGRAMME, Geologisches Landesamt Nordrhein-Westfalen, Krefeld (Germany, F.R.).  
For primary bibliographic entry see Field 7B.  
W82-00830

HYDROGEOLOGY OF THE SIERRA NEVADA FOOTHILL LINEAMENT NEAR OAKHURST, CALIFORNIA, California State Univ., Fresno. Dept. of Geology.

S. Mack, and K. D. Schmidt.  
Ground Water, Vol 19, No 2, p 149-155, March/April, 1981. 5 Fig, 2 Tab, 11 Ref.

Descriptors: \*Geologic history, \*Groundwater, \*Chlorides, Connate water, Granites, \*Sierra Nevada, California, \*Geohydrology.

The influence of hydrogeologic factors on the distribution of high chloride ground water is discussed for the Sierra Nevada Foothill lineament near Oakhurst, California. This northwest trending lineament extends for 60 miles along the western Sierra Nevada foothills of Fresno and Madera Counties and includes 33 wells and two springs. The high-chloride water was probably influenced by connate waters derived from the compaction of Paleozoic and early Mesozoic marine clastic rocks in the Sierra Nevada. If granitic plutons in the area are presumed to be fairly thin mushroom-like complexes emplaced in the upper crust, hydrogeologic relations are explained. Marine connate water migration upward more or less vertically from a fault zone beneath a capping of granitic rock defined the lineament. Excellent correlation was

found in the Oakhurst Basin between air-photo linear features and wells yielding high-chloride water. The persistence of the high-chloride water may be due to the high density of the connate water and the lack of deep circulation of meteoric water beneath topographically low areas.  
(Small-FRC)  
W82-00831

#### THE DECLINING GROUND-WATER RESOURCES OF ALLUVIAL VALLEYS: A CASE STUDY,

Geological Survey, Lawrence, KS.

For primary bibliographic entry see Field 4B.  
W82-00832

A COMBINATION OF ELECTRICAL RESISTIVITY, SEISMIC REFRACTION, AND GRAVITY MEASUREMENTS FOR GROUNDWATER EXPLORATION IN SUDAN, Groundwater Survey TNO, Delft (Netherlands).

R. A. van Overmeeren.

Geophysics, Vol 46, No 9, p 1304-1313, September, 1981. 10 Fig, 10 Ref.

Descriptors: Water resources development, \*Geophysics, \*Groundwater potential, Seismology, Gravity studies, Resistivity, Bedrock, Salinity, Exploration, \*Geohydrology, \*Sudan.

An integrated application of several geophysical exploration methods provided hydrogeologic information during groundwater exploration in the Sudan. Electrical resistivity, seismic refraction, and gravity methods were used to study prospects for additional supply of groundwater. Multilayer electrical sounding curves were already available and an additional 16 vertical electrical soundings were made. Seismic refraction work was carried out at selected locations to yield additional information on depths to bedrock. Using seismic data, a unique solution was found for the electrical sounding curves, from which it was concluded that groundwater in the area was saline. Drilling tests confirmed these findings. A regional relative Bouguer anomaly map gave a picture of the general geological structures and estimated depths to bedrock. In areas such as this where the basement rocks are close to the surface, gravity anomalies cannot be corrected with bedrock relief because of the strong influence of lateral density variations within the bedrock. Reliable data on depth to bedrock and formation resistivities could not have been obtained using only one of the techniques.  
(Small-FRC)  
W82-00852

#### A METHOD FOR ESTIMATING RECHARGE AND BOUNDARY FLUX FROM GROUND-WATER LEVEL OBSERVATIONS,

Institute of Hydrology, Wallingford (England).

P. J. Smith, and R. S. Wikramaratna.

Hydrological Sciences Bulletin, Vol 26, No 2, p 113-136, June, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: \*Groundwater recharge, \*Transmissivity, \*Water level, Fluctuations, Mathematical studies, Estimating equations, Groundwater management, Semiarid lands.

A new method is proposed for the estimation of recharge and boundary flux based on water level and transmissivity observations. It is particularly useful in semiarid regions where a steady state formulation can be used and recharge is confined to certain known areas. When this inferred recharge method is applied to a typical problem, it is an improvement over the implied recharge method. The variances for inferred recharge are satisfactory estimates of those obtained in simulations. Even when these variance estimates are large, alternative hypotheses can be tested about the mechanism of recharge using statistical significance tests. An error in the transmissivity distribution has less effect than an error of the same proportion in the water level observations, which means that this method can be useful in the early stages of modelling studies when only crude assessments have been made. These early results can aid

## WATER CYCLE—Field 2

### Water In Soils—Group 2G

in the design of a field data collection program.  
(Small-FRC)  
W82-00985

**WELL-FIELD DRAWDOWNS USING COUPLED AQUIFER MODEL.**  
Law Engineering Testing Co., Tampa, FL.  
L. H. Motz.  
Ground Water, Vol 19, No 2, p 172-179, March/April, 1981. 10 Fig, 6 Ref.

Descriptors: \*Drawdown, \*Aquifers, \*Wells, Model studies, Groundwater movement, Water table aquifers, Pumping tests, Evapotranspiration, Jay Starkey Wilderness Park, \*Florida.

A coupled aquifer model (Motz, 1978) was used to investigate well field drawdowns in the Jay B. Starkey Wilderness Park, Pasco County, Florida. In this model, water pumped from an underlying artesian aquifer originates from leakage through an overlying semipermeable confining bed. The source of this leakage is assumed to be a reduction in evapotranspiration from the overlying water table aquifer. The hydrologic coefficients in the coupled aquifer model were calibrated from observed pumping and water table data; water table and artesian aquifer drawdowns were estimated for different pumping rates. A coefficient of 0.00112 gpd per cu ft was obtained by matching calculated water table drawdowns to observed water table drawdowns caused by five production wells in the park. Five alternative plans for further well development were explored. The best plan recommended that the central and eastern parts of the park be developed. (Cassar-FRC)  
W82-00990

**DISSOLUTION OF SALT DEPOSITS BY BRINE DENSITY FLOW,**  
New Mexico Univ., Albuquerque. Dept. of Geology.

R. Y. Anderson, and D. W. Kirkland.  
Geology, Vol 8, No 2, p 66-69, February, 1980. 4 Fig, 12 Ref.

Descriptors: \*Salts, \*Radioactive waste disposal, Model studies, Waste disposal, Radioactive wastes, Flow, Flow system, Brines, Water pollution sources.

A brine density flow model is applied to the dissolution of evaporites, which has implications for the use of evaporite deposits for the storage of radioactive waste. A model simulating brine flow was constructed in which a source (aquifer) was connected to an overlying chamber containing salt by a capillary tube 0.54 m long and 0.0015 m in diameter. Water was driven through the tube by brine density difference alone and removed salt from the overlying chamber at a rate of about 1 gm/min. Continuous two way flow developed. Dissolution by means of brine flow within the Delaware Basin in western Texas is discussed, and it is suggested that similar processes may operate in other evaporite basins. Fracture systems that provide communication between pressurized and flowing fresh water aquifers and salt bodies have the potential for developing brine flow and a dissolution system. This can lead, as it has in the Delaware Basin, to collapse breccias. The potential for deep-seated dissolution by means of brine flow should be added to factors considered in risk assessment programs when considering waste repositories in evaporites. (Small-FRC)  
W82-01016

### 2G. Water In Soils

**MICROBIAL MOBILIZATION OF CALCIUM AND MAGNESIUM IN WATERLOGGED SOILS,**  
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.

M. P. Silverman, and E. F. Munoz.  
Journal of Environmental Quality, Vol 9, No 1, p 9-12, January-March, 1980. 2 Fig, 3 Tab, 18 Ref.

Descriptors: \*Soil water, \*Calcium, \*Magnesium, \*Bacteria, Metabolism, Microbiological studies.

Anaerobic conditions, Aerobic conditions, Biodegradation, Soil chemistry.

Direct measurements were made of changes in the concentrations of Ca and Mg in soil solutions as a consequence of microbial glucose metabolism and of the rates of Ca and Mg mobilization as affected by the presence or absence of atmospheric O<sub>2</sub>. Twelve California soils were amended with 0.5% glucose solution and incubated in air and anaerobically for two weeks under waterlogged conditions. In soil solutions incubated in air, there was a decrease of 1 to 2 units in the pH relative to control soils incubated without glucose. There was also a 2.4- to 29.4-fold increase in the Ca content and a 0.7- to 41-fold increase in the Mg content. Under anaerobic incubation a similar decrease in pH was determined, as well as 2.7- to 15.3-fold increases in Ca and 1.5- to 47-fold increases in Mg. Under incubation in air, the amounts of Ca and Mg increased for 3 to 10 days and then decreased. Under anaerobic conditions, concentrations reached maximum values in 7 to 10 days and did decrease later. Microbial production of various organic metabolites from glucose may be responsible for the release of Ca and Mg from exchange sites. In air, these metabolic products become susceptible to biodegradation, but they are relatively stable under anaerobic incubation. (Small-FRC)  
W82-00560

**EFFECT OF LEACHATE FLOW RATE ON METAL MIGRATION THROUGH SOIL,**  
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
For primary bibliographic entry see Field 5E.  
W82-00565

**A MATHEMATICAL MODEL FOR PREDICTING MOISTURE FLOW IN AN UNSATURATED SOIL UNDER HYDRAULIC AND TEMPERATURE GRADIENTS,**  
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.  
V. Dakshnamurthy, and D. G. Fredlund.  
Water Resources Research, Vol 17, No 3, p 714-722, June, 1981. 9 Fig, 2 Tab, 24 Ref.

Descriptors: \*Unsaturated flow, \*Soil properties, \*Pore pressure, Pore water, Soil gases, Soil water, Model studies, Mathematical models, Soil water movement.

A model is developed to predict the moisture flow in an unsaturated soil as a result of hydraulic and temperature gradients. Three partial differential equations (heat flow at above-freezing conditions, water phase and air phase) are solved simultaneously for changes in the combined thermal and hydraulic boundary conditions. Darcy's law is used to describe the flow in the water phase; Fick's law for the air phase; and Fredlund and Morgenstern's constitutive equations for the volume change of an unsaturated soil. Solving the equations produces the temperature, pore water pressure, and pore air pressure distribution with space and time in an unsaturated soil. From these values the quantity of moisture flow may be calculated. Four example problems involve prediction of the moisture flow in an unsaturated subgrade soil such as that below a highway or airfield. The information may also be used to study the dissipation of pore pressures in the compacted core material of an earthfill dam. (Cassar-FRC)  
W82-00605

**THE EFFECTS OF SODIUM AND ORGANIC MATTER IN SEWAGE EFFLUENT ON WATER RETENTION PROPERTIES OF SOILS,**  
The Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Science.  
For primary bibliographic entry see Field 3C.  
W82-00663

**ESTIMATION OF SOIL-MOISTURE CHARACTERISTICS FROM MECHANICAL PROPERTIES OF SOILS,**  
Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani (India). Dept. of Agricultural Engineering.  
R. K. Ghosh.

Soil Science, Vol 130, No 2, p 60-63, August, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: \*Soil water, \*Estimating equations, \*Soil properties, Mathematical studies, Soil water potential, Soil science.

An empirical technique was developed to estimate soil-moisture characteristics. Soil-moisture characteristics can be determined directly from soil physical properties and a single measurement of water potential in bars at some moisture content on a volume basis. The procedure is particularly useful when a reliable soil moisture characteristic curve is not available. Usually, the physical properties of soils can be obtained from published records of routine work for any geographical location. The method is applicable for those soils for which the water potential minus the moisture content can be expressed as the water potential equals the air-entry water potential in bars times the moisture content over the saturated water content after this fraction is raised to the power of a constant. Considerable agreement was found between estimated values using this procedure and experimentally determined values. (Small-FRC)  
W82-00785

**EFFECTS OF JOULE HEATING ON THERMO-COUPLE PSYCHROMETER WATER POTENTIAL DETERMINATIONS,**  
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 7B.  
W82-00892

**SUBSURFACE DRAINAGE AND SEDIMENT TRANSPORT MODEL,**  
Florida Univ., Gainesville. Dept. of Agricultural Engineering.

A. B. Bottcher, E. J. Monke, and L. F. Huggins.  
Transactions of the ASAE, Vol 23, No 4, p 870-876, July/August, 1980. 5 Fig, 15 Ref.

Descriptors: \*Sediment transport, \*Mathematical models, \*Subsurface drainage, Drainage, Sediments, Mathematical equations, Computer models, Simulation, Groundwater movement, Flow characteristics.

Since root zone drainage is the main incentive for subsurface drainage, most research in this area has concentrated on water movement; however, the waters involved can carry substantial amounts of sediments and nutrients. A computer model was developed which uses the GASP IV simulation language to simulate water flow and sediment movement from a subsurface drainage system and to predict these activities as a function of time for both single and multistorm events. The flow portion of the model uses a one-dimensional form of the Richard's equation and a steady state tile flow formula by Toksoz and Kirtham (1961). The output of the flow portion of the model directly controls the particle detachment portion of the model, which is based on a force balance relationship. The sediment flush observed at the beginning of some flow events is adequately described by an exponential decay function. Data collected from a 17 hectare drainage system on a Hoytville silty clay soil were used for calibration and directly proportional to drain flow, while drain flow and rainfall were continuously recorded. Moisture deficit replenishment coefficients, deep seepage, and saturated hydraulic conductivity were calibrated. The model was verified through simulation of the most active flow period of the two years during which data were collected. Comparison of the model results with observed data indicated that the model can reliably predict water yield, sediment yield, and the sediment concentration curve. There was, however, some difficulty in simulating the actual shape of the flow hydrograph. This model should facilitate planning for compliance with section 208 of the Federal Clean Water Act and provide a base for more complex nutrient and pesticide transport models. (Carroll-FRC)  
W82-00894

## Field 2—WATER CYCLE

### Group 2G—Water In Soils

**RESIDENCE TIMES OF WATER AND SOLUTES WITHIN AND BELOW THE ROOT ZONE,**  
Institute of Soil Fertility, Groningen (Netherlands).

P. A. C. Raats.  
Agricultural Water Management, Vol 4, No. 1-3, p 63-82, 1981. 9 Fig, 43 Ref.

**Descriptors:** \*Estimating equations, \*Soil water, \*Solute transport, Mathematical studies, Solutes, Salinity, \*Root zone, Water quality, Agriculture, \*Netherlands.

An approach is presented to the analysis of simultaneous transport of water and solutes within the root zone and in the region between the water table and drains, ditches, or streams. Equations are presented which indicate that within the root zone the travel speed of the water or solute depends primarily on the components of the overall water balance, the average water content, and the distribution of the water uptake. Recent attempts to infer water uptake from salinity data are discussed, as are transport to drains, ditches, or streams induced by an input distributed uniformly over the soil surface. If the ratio of the half-spacing between ditches, drains, or streams and the depth to the impermeable layer is larger than about five, the following are true: The isotherms are horizontal except close to the outlets, and the transit time density distribution is approximately exponential. Estimates are presented for the retardation due to adsorption, for the influence of reactions, and for the influence of dispersion. (Small-FRC)  
W82-00932

**MODELING WATER FLUX ON STRIP-MINED LAND,**  
Science and Education Administration, Northeast Watershed Research Center, University Park, PA. A. S. Rogowski, and B. E. Weinrich.  
Transactions of the ASAE, Vol 24, No 4, p 935-940, July/August, 1981. 6 Fig, 4 Tab, 17 Ref.

**Descriptors:** \*Model studies, \*Flow measurement, \*Soil water, Fluid flow, Flow pattern, Flow profiles, Spoil banks, Mine wastes, Strip mine wastes, Strip mines, Appalachia, \*Land reclamation.

An attempt was made to model numerically the infiltration and redistribution of water in reclaimed topsoiled and nontopsoiled Appalachian minesols. In these minesols, large size fractions predominate. It was determined that infiltration and redistribution of applied water on topsoiled spoil profiles could be adequately modeled with numerical techniques using either experimentally determined values or moisture characteristics corrected for coarse fragment content and hydraulic conductivities derived from seepage flux. On nontopsoiled profiles, numerical techniques appear inadequate, and a better fit to experimental data can be obtained by subtracting from the flux the amount of water retained by the fine particles and the amount retained on the surface of coarse fragments and then considering the flux to be a function of gravity alone. However, even this approach is not completely satisfactory. At times, when the profile is reasonably dry, water seems to move rapidly through larger channels in the coarse spoil materials without appreciably wetting the rest of the profile. (Baker-FRC)  
W82-00944

### DRYLAND MANAGEMENT FOR SALINITY CONTROL,

J. Van Schifsgaarde.  
Agricultural Water Management, Vol 4, No 1/3, p 383-391, 1981. 18 Ref.

**Descriptors:** \*Salinity, \*Water quality management, Water quality, Water resources development, Evapotranspiration, Salt balance, Salts, Farming, \*Cropland, Vegetation, Reforestation, Recharge basins, \*Great Plains.

Management of salinity in dryland areas may be approached through the maintenance or enhancement in situ of agricultural production, or it may be approached through increasing the yield of

good quality water. In the Northern Great Plains of North America, the primary concern is the loss of agricultural production, and solutions to this are sought through the prevention of new and the reclamation of existing salt seeps. This can be accomplished at the recharge site by changing the water balance, or dealt with downstream. In the Red River Valley of North Dakota a different problem exists in that some 160,000 ha of agricultural lands have saline water tables near the surface. In the Lower Rio Grande Valley of Texas, some 40,000 ha of cultivated, nonirrigated soils have salinity problems. The problem facing Western Australia is similar to that of the Northern Great Plains. Excess water percolation due to changes in vegetation resulted in increased lateral movement through semiconfined aquifers. The salts involved are dominantly chlorides deposited in rainfall, and more emphasis is placed here on downstream water quality than on agricultural production. In order to correct dryland salinity problems, various soil properties must be investigated. The most important soil property for the evaluation of water and salt fluxes is the hydraulic conductivity. There are still many difficulties with measuring this property. When changes in water quality are the primary item of interest, the historically well-developed application of potential theory is more useful when interpreted in terms of the stream function rather than the potential function. (Baker-FRC)  
W82-01018

### SOIL PERCOLATION TESTS,

Indian Health Service, Seattle, WA. Office of Environmental Health.

M. E. Peterson.  
Journal of Environmental Health, Vol 42, No 4, p 182-186, January/February, 1980. 2 Fig, 7 Ref.

**Descriptors:** \*Soil properties, \*Percolation, \*Soil water, Leaching, Seepage, Water loss, Infiltration, Capillarity, Measuring instruments, Testing procedures, Standards.

Even though there is severe criticism of the percolation test, it is still used consistently by private, county, state, and federal agencies throughout the United States. Unless the operator is keenly aware of the sources of error in this test, accurate results will be the exception, not the rule. A recommended procedure is offered. Three or more holes should be dug, spaced uniformly over the proposed site, avoiding the use of tools that will compact or smear the soil interface of the holes. Holes should have a diameter of exactly 8 inches. The bottom and sides of the holes should be carefully scraped with a hard rake or other instrument to provide as natural a soil interface as possible, and loose material removed from the bottom of the holes. Perforated liners should be inserted vertically in the holes and gravel or some other porous supporting material carefully placed between the outside of the liner and the hole wall. About 2 in of gravel should be added to the bottom of the hole. Holes should be presoaked to assure saturation and swelling of the soil. The percolation time is then measured. A percolation tube is described which facilitates the performance of the test. In addition to performing a percolation test at the site, it is highly recommended that a deep boring be made to look for high groundwater elevation and the presence of bedrock or other unique soil boundaries. (Baker-FRC)  
W82-01044

### RESPONSE OF FABABEAN YIELD, PROTEIN PRODUCTION AND WATER USE TO IRRIGATION,

Department of Agriculture, Lethbridge (Alberta). Research Station.  
For primary bibliographic entry see Field 2I.  
W82-01089

### 2H. Lakes

#### ANTHROPOGENIC TRACE ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBON LEVELS IN SEDIMENT CORES FROM TWO

### LAKES IN THE ADIRONDACK ACID LAKE REGION,

Department of Energy, NY. Environmental Measurements Lab.

For primary bibliographic entry see Field 5B.  
W82-00501

### SAMPLING EMERGING CHIRONOMIDAE (DIPTERA) WITH SUBMERGED FUNNEL TRAPS IN A NEW NORTHERN CANADIAN RESERVOIR, SOUTHERN INDIAN LAKE, MANITOBA,

Department of Fisheries and Oceans, Winnipeg (Manitoba), Freshwater Inst.

D. M. Rosenberg, A. P. Wiens, and B. Bily.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 927-936, June, 1980. 7 Fig, 4 Tab, 14 Ref.

**Descriptors:** \*Midges, \*Sampling, \*Population density, Lakes, Trap efficiency, Trapping, Canada.

As part of a study on the effects of reservoir formation on Chironomidae in Southern Indian Lake, the experimental design is discussed and the sampling characteristics of the submerged funnel traps are described. Clay, bedrock, and marsh shorelines were sampled at 1.0, 2.0, 3.5, and 4.5 m depths with four replicate traps at each location. The most common offshore species differed from the most common inshore species. All offshore species were similar but inshore marsh species differed from clay and bedrock species. Precision was estimated at + or - 30% for the twelve traps at each depth and 16 traps for each shoreline type. A minimum of four traps was required to interpret emergence patterns of the most common species with one emergence peak while 16 were required if there were two emergence peaks. Continuous and discontinuous trapping gave similar results. Results indicate that the optimum sampling strategy for mesotrophic lakes would be to trap discontinuously and use many traps. (Small-FRC)  
W82-00520

### DIEL VARIATIONS OF SELECTED PHYSICO-CHEMICAL PARAMETERS IN LAKE KISSIMMEE, FLORIDA,

Florida Dept. of Environmental Regulation, Tallahassee.

C. W. Dye, D. A. Jones, L. T. Ross, and J. L. Gernert.  
Hydrobiologia, Vol 71, No 1/2, p 51-60, May 27, 1980. 7 Fig, 3 Tab, 30 Ref.

**Descriptors:** \*Water quality, \*Productivity, \*Shallow water, Photosynthesis, \*Lake Kissimmee, Florida, Lakes, \*Physicochemical properties, Mixing, Conductivity, Wind, Destratification, Hydrogen ion concentration, Dissolved oxygen, Temperature.

Lake Kissimmee, Florida (137 sq km, mean depth 2.5 meters) may be typical of the state's lakes in the central portion of the peninsula. The diel depth profiles of dissolved oxygen, pH, temperature and conductivity made at 2 stations from July 1974 to June 1975 suggest that stratification does not occur. However, a large temperature gradient (about 5 degrees C) appeared on 2 occasions, in July and December 1974, on clear, dead calm days. Generally, any temperature differences disappeared with convective cooling at night and with wind mixing. Dissolved oxygen levels were high, maximum 11.6 mg per liter, and on rare occasions, as low as 4 mg per liter at the bottom during extreme calm in summer. Photosynthesis was the primary factor regulating pH, which was maximum in summer and in afternoon, coinciding with periods of maximum productivity. Conductivity was highest in the wet summer months and lowest during the winter dry season. The anomalous summer increase was probably a result of sewage effluent released into lakes in the Upper Basin chain which in turn flowed into Lake Kissimmee. In winter, water is not discharged from the Upper Basin. (Cassar-FRC)  
W82-00535

## Lakes—Group 2H

**RELATIONSHIP BETWEEN THERMAL STABILITY AND SUMMER OXYGEN DEPLETION IN A PRAIRIE POTHOLE LAKE,**

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

M. H. Papst, J. A. Mathias, and J. Barica.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1433-1438, September, 1980. 6 Fig, 14 Ref.

**Descriptors:** \*Lakes, \*Temperature effects, \*Oxygen depletion, Eutrophication, Seasonal variation, Algal growth, Prairies, Thermal stratification, Lake breezes, Mixing, \*Fishkill.

Periods of oxygen depletion in prairie pothole lakes which cause summer fishkill have been associated with the collapse of algal blooms, but are not necessarily caused by this collapse. The thermal instability which sometimes follows this collapse plays an important role in summerkill. Thermal stability of the pothole lakes is dependent on wind stress and night-time air temperatures. The present results aid in determining the speed with which oxygen depletion may occur, and correlate the occurrence of periods of lake oxygen depletion with variations in weather conditions. The algal biomass may collapse without severe oxygen depletion in these lakes. (Geiger-FRC)  
W82-00545

**A PROCEDURE USING MODELING AND ERROR ANALYSIS FOR THE PREDICTION OF LAKE PHOSPHORUS CONCENTRATION FROM LAND USE INFORMATION,**

Michigan State Univ., East Lansing. Dept. of Resource Development.

For primary bibliographic entry see Field 5G.  
W82-00546**MODEL OF THE SEASONAL DYNAMICS OF AN ECOSYSTEM OF A SHALLOW LAKE,**

Akademiya Nauk SSSR, Moscow. Inst. of Limnology.

O. V. Belyakova.

Water Resources (English Translation), Vol 7, No 5, p 450-457, September/October, 1980. 4 Fig, 24 Ref. Translated from *Vodnye Resury*, No 5, p 130-139, September/October, 1980.

**Descriptors:** \*Mathematical models, \*Seasonal variation, \*Ecosystems, \*Lakes, Mathematical equations, Water temperature, Temperature effects, Solar radiation, Biomass, Aquatic productivity, Energy, Shallow lakes.

In order to understand and predict the reaction of a lake ecosystem to varying external effects, it is first necessary to create a mathematical model of the seasonal dynamics of the components of the ecosystem. The development of a mathematical model of the seasonal dynamics of the biomass and production of the main trophic groups of aquatic organisms and of the concentrations of biogenic elements is discussed. The inputs of the system are the mean monthly values of absorbed solar radiation, the temperature of the water mass, inflow and outflow of the lake, and the amount of production of macrophytes. The outputs of the system include dissipation of heat energy during the vital activity of aquatic organisms, the biomass of chironomids that have emerged and flown away, and the consumption of zooplankton and benthos by fishes. The results obtained on the model were compared with data obtained by direct observation on a mesotrophic lake in northwestern U.S.S.R. This comparison showed that the model provided a satisfactory reproduction of both the overall level of development and seasonal dynamics of the main components of the lake ecosystems. This model can be used to evaluate the role of the main trophic links in the seasonal dynamics of the flow of material and energy in the lake and to evaluate the possible responses of the system to quantitatively different regimes of the input variables. However, it is not suitable for evaluation of potential responses to large disturbances which would create the basis for a different energy regime. (Carroll-FRC)

W82-00552

**PROBABILITY-THEORETICAL ANALYSIS OF FLUCTUATIONS IN THE LEVEL OF A CLOSED WATER BODY,**

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.

S. V. Muzylev.

Water Resources (English Translation), Vol 7, No 5, p 403-417, September/October, 1980. 6 Fig, 31 Ref. Translated from *Vodnye Resury*, No 5, p 21-41, September/October, 1980.

**Descriptors:** \*Closed lakes, \*Hydrologic budget, \*Mathematical studies, Mathematical equations, Climatology, Water level fluctuations, Lakes, Stochastic process.

Closed lakes are water bodies from which rivers do not flow. The natural regimes of most of these closed water bodies have been substantially disturbed by economic measures related primarily to irrigation and streamflow regulation. In order to predict the regime of closed lakes, it is first necessary to develop a physical model which correctly reflects the regularities of the fluctuations of their levels. Previous models based on the stochastic character of river inflow and apparent evaporation used a discrete form of notation of the annual increments of components of the water balance. However, all physically real stochastic processes represent continuous functions of time. The use of the concept of continuous processes reduces the problem of water level fluctuations in a closed lake to classical problems of nonequilibrium statistical mechanics and statistical radio engineering. A continuous model describing the fluctuations of the level in a closed water body was used to obtain a quantitative estimate of the effect of the product of level fluctuations and river inflow on the statistical characteristics of the level. This effect can be neglected when the inflow variability is small, but not when the coefficients of variation of the inflow are close to unity. In the simplest case, the correlation function of level fluctuations corresponds to the component of the two-dimensional Markov process. When lags far exceed the correlation time of inflow and apparent evaporation, a first-order Markov process describes the level fluctuations sufficiently well. This continuous model permits identification of the characteristics to the case of cross correlation of the river inflow and apparent evaporation. (Carroll-FRC)  
W82-00571

**MICROBIAL METABOLISM OF N-NITROSOETHANOLAMINE IN LAKE WATER AND SEWAGE,**

Cornell Univ., Ithaca, NY. Soil Microbiology Lab. J. R. Yordy, and M. Alexander.

Applied and Environmental Microbiology, Vol 39, No 3, p 559-563, March, 1980. 7 Fig, 16 Ref.

**Descriptors:** \*Nitrogen compounds, \*Metabolism, \*Lakes, \*Wastewater, Microbial degradation, Microorganisms, Seasonal variations, Nitrosamines, Mineralization.

The transformation of N-nitrosodiethanolamine (NDEIA) was studied in samples of lake water and sewage. Water samples were taken from North Lake in the Adirondack Preserve and from Cayuga Lake, both in New York State. Samples were taken about 1 m from the shore, at surface level. Sewage samples at pH 7.8 were collected from the primary settling tank at the Ithaca, NY sewage treatment plant. The mineralization of NDEIA in samples of these three waters was studied. At NDEIA concentrations of 1.1 microgram/ml, mineralization was never noted in the Cayuga Lake and North Lake water samples, even though the process was examined with water collected at different times of the year. In sewage, NDEIA was mineralized, with over 40% of the carbon added as NDEIA being recovered as CO<sub>2</sub> when the experiments were completed. Even though NDEIA was not mineralized in the lake water samples, the nitrosamine was metabolized. Breakdown of about 1.0 micrograms of NDEIA per ml in North Lake water and Cayuga Lake water was caused by microorganisms. In North Lake only partial degradation was noted in the September sample, which suggests that depletion of an essential nutrient occurred in the water sample. In sewage, no seasonal

variation on the microbial conversion was noted, and the products of metabolism were slowly mineralized. NDEIA was apparently converted to the same organic products in all three samples. Data suggest that these products were modified dimers of NDEIA. (Baker-FRC)  
W82-00585

**ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,**

Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.

For primary bibliographic entry see Field 5C.  
W82-00592**THEORY OF ECOLOGICAL PREDICTION OF LIMNETIC ECOSYSTEMS,**

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.

For primary bibliographic entry see Field 6G.  
W82-00597**INFLUENCE OF SEASONAL TEMPERATURE ON THE TEMPERATURE OPTIMA OF BACTERIA IN SEDIMENTS OF LAKE GEORGE, NEW YORK,**

Oregon State Univ., Corvallis. Dept. of Microbiology.

D. L. Tison, D. H. Pope, and C. W. Boylen. Applied and Environmental Microbiology, Vol 39, No 3, p 675-677, March, 1980. 1 Fig, 1 Tab, 12 Ref.

**Descriptors:** \*Bacteria, \*Temperature effects, Lakes, \*Lake George, Seasonal variations, Sediments, Nutrients, Nutrient cycling, Littoral zone, Lake sediments, New York.

The possibility of temperature limiting microbial activity in Lake George during periods of nutrient input and throughout the winter was investigated. Sediment samples were collected from a depth of 1 meter with an Ekman dredge and diluted 1:1 (vol/vol) with lake water. Temperature optima for the heterotrophic utilization of glucose and an amino acid mixture were determined throughout the year. The temperature optimum decreased with decreasing in situ temperature in the fall and winter, suggesting that selection for or adaptation by a psychrotrophic bacterial population occurred. Replicate plating of bacterial isolates from 3 and 20 degrees C indicated that a psychrotrophic bacterial population was present in the sediments throughout the year. These results indicate that decomposition and nutrient cycling processes in the sediments within the littoral zone of Lake George were probably not completely inhibited by winter temperatures, although the process rates were decreased. Utilization rates for glucose in January were about 30% of those in August, but this was thought to be due to a decrease in the numbers of active microorganisms or limitations due to factors other than temperature during the winter. (Baker-FRC)  
W82-00606

**CONTROL OF WATER WEEDS BY GRASS CARP IN TWO SMALL LAKES,**

Marine Dept., Rotorua (New Zealand). Fisheries Research Div.

For primary bibliographic entry see Field 3B.  
W82-00609**ACUTE AND CHRONIC EFFECTS OF ALUM TO MIDGE LARVA (DIPTERA: CHIRONOMIDAE),**

Kennedy (Michael), Spokane, WA.

For primary bibliographic entry see Field 5F.  
W82-00650**SEDIMENTS AS A SOURCE OF PHOSPHATE: A STUDY OF 38 IMPOUNDMENTS,**

Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.

D. C. Grobler, and E. Davies. Water S A, Vol 7, No 1, p 54-60, January, 1981. 3 Fig, 4 Tab, 15 Ref.

## Field 2—WATER CYCLE

### Group 2H—Lakes

Descriptors: \*Lake sediments, \*Phosphates, \*Algal growth, Eutrophication, Suspended sediments, Bottom sediments, Phosphorus, \*Nutrients, Nuisance algae, Algae, Catchment areas, Reservoirs, Mathematical studies, \*South Africa.

The amount of sediment phosphate available as nutrients for algal growth was examined in sediments from 38 South African impoundments. *Seleniastrum capricornutum* was used in a bioassay technique to determine the availability of sediment phosphate in a 21 day incubation period. When impoundments were grouped according to the geological formation of their catchments, the algal available phosphate fraction and the inorganic phosphate content of the sediments were correlated. Two regression equations were proposed to calculate the algal available phosphate level of the sediments when the inorganic phosphate levels of the sediments are known. In turbid or shallow impoundments the phosphate content of suspended sediments should also be considered as a source of algal nutrients. It was suggested that these data be considered when imposing phosphate standards in South Africa for eutrophication management. (Geiger-FRC) W82-00653

#### DISTRIBUTION AND BIOLOGICAL AVAILABILITY OF REACTIVE HIGH MOLECULAR WEIGHT PHOSPHORUS IN NATURAL WATERS IN NEW ZEALAND,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section. E. White, and G. Pane.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 664-669, April, 1980. 2 Fig, 4 Tab, 8 Ref.

Descriptors: \*Phosphorus, \*Eutrophic lakes, \*Algal growth, Streams, Phosphates, Eutrophication, Dissolved solids, Water pollution effects, Turnover time, Absorption, Nutrients, Chlorophyta, Algae, \*New Zealand.

Dissolved phosphorus which is not orthophosphate is present in many eutrophic lakes and streams of the central volcanic plateau of North Island, New Zealand. One of the reactive phosphorus components was shown by Sephadex gel chromatograms to have a molecular weight of over 5000, while a second component elutes at phosphate-phosphorus. The reactive high molecular weight phosphorus (RHMW-P) usually forms only a small fraction of the dissolved reactive phosphorus (DRP) in streams. In some eutrophic lakes, a characteristic distribution of the two forms exists and the RHMW-P/DRP ratio may be as high as 70-80%. In summer months phosphate-phosphorus dominates over RHMW-P, a situation consistent with the long phosphate turnover rates peculiar to many lakes of this region. Algal growth responses to phosphorus uptake were similar for phosphate-phosphorus and RHMW-P, but the amount of RHMW-P taken up by Chlorella varied from lake to lake. This caused problems in relating lake DRP levels to algal growth responses. (Geiger-FRC) W82-00659

#### COMPARISON OF A FEW SYSTEMS FOR THE DETERMINATION OF SAPROBIC AND TROPHIC DEGREE ON THE BASIS OF PLANKTON DATA,

Katholieke Univ., Nijmegen (Netherlands) Lab. of Aquatic Ecology.

G. J. Van Nuland, and J. F. G. M. Meis. Hydrobiologia, Vol 70, No 3, p 251-256, May 2, 1980. 1 Fig, 2 Tab, 27 Ref.

Descriptors: \*Plankton, \*Saprobic index, \*Trophic level, Ecosystems, Mesotrophy, Water quality, Lakes, Biological properties, Phytoplankton, Zooplankton, Nutrients, Species composition, Comparison studies, Aquatic environment.

The biological quality of an aquatic environment, the Haarstege Wiel, Vlijmen, the Netherlands, was determined by five different methods. Two methods involved the saprobity; two, the trophic level; and one, chemical data. This water body, which formed following dike bursts on the River

Meuse in 1610 and 1740, was studied from April to October 1977. The two methods for determining saprobic index showed, in good agreement, that the water was within the transition range between beta-mesosaprobic and oligosaprobic. The Zelinka and Marvan (1961) method, developed in Czechoslovakia, is to be used with a well-defined community, such as plankton, benthos, or epiphyton (in this study, plankton) and requires an extremely accurate identification of organisms. The Dresscher and van der Mark (1976) technique uses several indicator species in a formula for saprobic index. Since detailed identification is not necessary, it saves time. Objections to this method are the generalization and the disregard of quantities of species found. The methods for determining trophic degree, those of Hutchinson (1967), Rawson (1956), and chemical data, all indicated the Haarstege Wiel to be mesotrophic. (Cassar-FRC) W82-00664

productivity, 31-80 micro S per cm at 20 degrees C. The 12 black water lakes had the highest Secchi disk transparencies, 95-299 cm. The four mixed lakes were highest in phosphates, 0.49-4.4 micrograms per liter. Physicochemical parameters with less defined differences among the lakes were: KMnO<sub>4</sub>, chloride, dissolved organic carbon, and temperature. White water lakes had the highest concentrations of saprobic bacteria, total bacteria, chlorophyll a, and microcrustaceans. Primary production (in mg C per sq meters per day) had a large range: white, 350-1500; mixed, 820-3500; and black 347-10451. Algae in the lakes further characterized the lake waters. White waters were dominated by Melosira, black waters (lower species diversity) by Peridinium, and mixed waters (greatest species diversity) by clean water indicators. (Cassar-FRC) W82-00666

#### VERTICAL DISTRIBUTION OF MONOSACCHARIDES IN LAKE WATER,

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.

M. Ochiai, and T. Hanya. Hydrobiologia, Vol 70, No 1/2, p 165-169, April, 1980. 3 Fig, 3 Tab, 12 Ref.

Descriptors: \*Carbohydrates, \*Organic matter, \*Monosaccharides, \*Lakes, Glucose, Galactose, Eutrophic lakes, Dystrophic lakes, Water analysis, Phytoplankton, Heterotrophic bacteria.

Eight common monosaccharides of the dissolved organic matter were measured in 3 Japanese lakes: Nakanuma, small and eutrophic; Suwako, shallow and eutrophic; and Shirakoma-ike, dystrophic. The ratio of concentrations of carbohydrates analyzed by gas chromatography to those analyzed by the anthrone method ranged from 30.5 to 121% in Suwako, 12.9 to 51.4% in Nakanuma, and 21.2 to 38.6% in Shirakoma-ike. In surface water of Lake Suwako (eutrophic) glucose and galactose represented 40% and 24.4%, respectively, of the carbohydrates, and 16.4 to 19.2% and 18.5 to 19.8%, respectively, in the deeper water. Rhamnose made up 12.2% of surface water carbohydrates and 23.9 to 25.8% in deeper waters. Ribose and arabinose were low from surface to 5 meters; fucose, xylose, and mannose were present in intermediate concentrations. Lake Nakanuma monosaccharide levels were on the same order. In dystrophic Lake Shirakoma-ike, the vertical profiles of most monosaccharides were relatively uniform; galactose, glucose, and mannose were in greatest concentrations, but at smaller concentrations than in the eutrophic lakes. (Cassar-FRC) W82-00665

The main factors regulating the temporal and spatial variations in water transparency in a turbid subtropical impoundment (Rust der Winter Dam, South Africa) were allochthonous inputs of silt during summer floods, impoundment morphometry, and the warm monomictic thermal cycle. Statistically significant relationships were established between Secchi disk transparency (0.6-3.00 meters), surface water turbidity (4.2-25 JTU), mean diffuse attenuation coefficient (0.64-2.00 per meter), and beam attenuation coefficient (1.14-10.60 per meter without a filter). These relationships allowed an approximation of the 1% of surface light intensity depth (corresponding with the euphotic zone) to be made if any one of the parameters were known. Blue light attenuation was greater than red light attenuation because of the effects of suspended clay particles. (Cassar-FRC) W82-00667

#### ANNUAL SUCCESSION OF PHYTOPLANKTON IN ONE HEATED POND IN CENTRAL FINLAND,

Jyvaeskylae Univ. (Finland). Dept. of Biology. For primary bibliographic entry see Field 5C. W82-00673

#### CHEMICAL COMPOSITION OF INTERSTITIAL WATERS IN BOTTOM SEDIMENTS OF SOME POLISH LAKES OF THE Wigry GROUP (NORTHERN POLAND),

Akademie Rolnicza, Warsaw (Poland). Zaklad Limnologii i Rybactwa. A. Woroniecka-Stasiak. Acta Hydrobiologica, Vol 22, No 4, p 347-360, 1980. 5 Fig, 2 Tab, 12 Ref.

Descriptors: \*Interstitial water, \*Lakes, \*Chemical properties, Bottom sediments, Acidity, Alkalinity, Hydrogen ion concentration, Carbon dioxide, Organic acids, Ammonium salts, \*Poland, Chemical composition.

The chemical composition of interstitial waters in the sediments of Wigry lakes was investigated in nine lakes. Fifty-one to 65% of sediment weight was interstitial water, and the most important feature of the water was the acid pH, which ranged from 5.6 in Lake Suchar to 6.9 in Lakes Krzywe and Omulowek. High alkalinity was found in the interstitial waters of Lakes Wigry, Omulowek, Krzywe, Muliczne, and Przetaczek. The remaining

## Lakes—Group 2H

lakes had water of the acidic-dystrophic type. A linear relationship was found between alkalinity and the pH values of interstitial waters saturating some sediments. In harmonic lakes, the acid relation was conditioned by the occurrence of free CO<sub>2</sub>, and in disharmonic lakes by the occurrence of free CO<sub>2</sub> and organic acids. Interstitial waters were a source of organic compounds and mineral salts to the hypolimnia and contained large amounts of iron and phosphorus. Large amounts of ammonium salts were found. In harmonic lakes, denitrification was responsible for the absence of nitrates and nitrites. (Small-FRC)  
W82-00675

**ORGANOCHLORINE RESIDUES IN KENYA'S RIFT VALLEY LAKES,**  
National Wildlife Federation, Washington, DC.  
For primary bibliographic entry see Field 5A.  
W82-00690

**THE CHANGING STATUS OF REEDSWAMP IN THE NORFOLK BROADS,**  
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.  
For primary bibliographic entry see Field 5C.  
W82-00691

**REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,**  
International Joint Commission—United States and Canada, Windsor (Ontario).  
For primary bibliographic entry see Field 5G.  
W82-00705

**AN IN SITU METHOD FOR MEASURING THE PRIMARY PRODUCTIVITY AND STANDING CROP OF THE EPILITHIC PERiphyton COMMUNITY IN LENTIC SYSTEMS,**  
California Univ., Davis. Div. of Environmental Studies.  
For primary bibliographic entry see Field 7B.  
W82-00756

**INTERACTION OF ORTHOPHOSPHATE WITH IRON (III) AND ALUMINUM HYDROXIDES,**  
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Engineering.  
L. Lijklema.  
Environmental Science and Technology, Vol 14, No 5, p 537-541, May, 1980. 5 Fig, 34 Ref.

Descriptors: \*Coagulation, \*Phosphates \*Lakes, \*Iron, \*Aluminum, Water treatment, Tertiary wastewater treatment, Wastewater treatment, Chemical reactions, Hydrogen ion concentration, Eutrophication, Lake sediments, Metals, Adsorption.

The influence of pH and aging on phosphate binding by Fe(3+) or aluminum hydroxides is pertinent to water and wastewater treatment and to phosphate exchange between sediments and overlying water in lakes. In laboratory studies, similarly-shaped adsorption isotherms of phosphates on Fe(3+) hydroxide or aluminum hydroxide were obtained at pH values of 5, 6, 7, and 8. Phosphate-P concentrations varied from 0 to 0.2 nmol per liter; ratios of P adsorbed per Fe concentration varied from 0.05 to 0.2. Phosphate adsorption was greater at lower pH and at higher phosphate concentrations. More phosphate was adsorbed when the hydroxides were formed in situ. Freshly precipitated Fe(3+) hydroxide adsorbed more phosphate than 1-day-old precipitates. Ratios of adsorbed phosphate to Fe increased linearly with time over the 1000 hours of the study. Adding acid or base to shift the pH 2 units showed that adsorption and desorption changes are not completely reversible. Practical conclusions drawn from this work are: (1) rapid initial mixing of coagulants in treatment plants is most effective; (2) at low temperatures and slightly acidic waters the effective phosphate adsorption can result in negatively charged phosphated complexes, resisting coagulation; (3) at pH 5 phosphate can remove Fe from iron-containing water by membrane filtration with

a 0.2 micrometer filter; (4) in lakes, a variation of pH produced by photosynthetic activity can influence the adsorption capacity of the sediment; (5) high release of phosphate and Fe can occur in shallow lakes under reducing conditions throughout the sediment and with high pH in the overlying water. (Cassar-FRC)  
W82-00783

**THE EFFECT OF SEASON AND LOCATION ON PHOSPHOADEYLYATE CONCENTRATIONS AND ADENYLATE ENERGY CHARGE IN TWO SPECIES OF FRESHWATER CLAMS,**  
Savannah River Ecology Lab, Aiken, SC.

J. P. Giesy, and G. W. Dickson.

Oecologia, Vol 49, No 1, p 1-7, 1981. 3 Fig, 8 Tab, 36 Ref.

Descriptors: \*Clams, Ponds, Reservoirs, Lakes, \*Savannah River impoundments, Mollusks, Rivers, Phosphates, \*Adenosine triphosphate, Baseline studies, Seasonal variation, Monitoring, \*Bioindicators, Cooling ponds, \*Nuclear powerplants.

Seasonal and size related variations of adenosine triphosphate (ATP), adenosine diphosphate (ADP), 5'-adenylc acid (AMP) and total adenylate concentrations were determined in the papershell clam and Asian clam. The adenylate energy charge was also investigated. Papershell clams were collected from the thermally enriched portion of Par Pond, an impoundment on the U.S. Department of Energy's Savannah River Plant, near Aiken, SC. Asian clams were collected from the Savannah River adjacent to the Savannah River Plant. Seasonal variations were readily observable in all three adenylates as well as in the total adenylate concentration and the adenylate energy charge for each species. The periods of active reproduction cycles for each species were closely tied with the fluctuations in adenylates and energy charges. Possible relationships of the various concentrations measured to the shell length of individual animals were investigated. The different points of collection did not appear to influence the value of the adenylate energy charge on individuals of either species. The adenylate energy charge of the Asian clam was seen to increase after acclimation had occurred to laboratory surroundings and feedings had begun. A deeper understanding of adenylate energy charges and adenylate concentrations is necessary before these parameters can be used as part of a natural background in monitoring programs. (Baker-FRC)  
W82-00810

**FACTORS INFLUENCING FISH DISTRIBUTION IN TWO DESERT RESERVOIRS, CENTRAL ARIZONA,**  
Arizona State Univ., Tempe. Forestry Sciences Lab.  
J. N. Rinne, W. L. Minckley, and P. O. Bersell.  
Hydrobiologia, Vol 80, No 1, p 31-42, April, 1981. 4 Fig, 10 Tab, 47 Ref.

Descriptors: \*Reservoirs, \*Fish, \*Limnology, Temperature effects, Thermoclines, Dissolved oxygen, Seasonal variation, Littoral environment, Littoral zone, Euphotic zone, \*Fish populations, \*Arizona.

Sampling of fishes, net plankton, phytoplankton pigments, and benthos began in the summer of 1970 and ended in autumn of 1971 in two desert reservoirs in central Arizona. The two reservoirs were Roosevelt Lake and Apache Lake. At full pool Roosevelt Lake approaches Apache Lake in maximum and mean depths, but is far larger, having almost six times the volume of Apache, twice the shoreline, and six times the mean breadth and surface area. The slope is far less severe in Roosevelt Lake. Temperature profiles vary substantially over time in these two low desert lakes, and annual cycles were similar in the two reservoirs. A basic difference between the two was in the depth of the metalimnion, which was located from 10 to 15 m in Roosevelt Lake, and at about half that depth, 5 to 7 meters, in Apache. This was attributable to wind action on the broad, unprotected surface of the former in contrast to the fjord-like nature of Apache Lake. Dissolved

oxygen curves generally paralleled seasonal temperature profiles, with high concentrations from surface to bottom during winter and spring and hypolimnic oxygen deficiencies during the summer. Apache Lake was far more transparent. No single factor appeared paramount in delimiting fish population dispersion in the two desert reservoirs. The greatest abundance of fish based on vertical gillnet catches was in the upper 10 meters of water, reflecting the influence of thermocline depth, levels of dissolved oxygen concentration, and euphotic zone. Fish introduced into western reservoirs are intrinsically shallow-water, littoral inhabitants, and remain so due to inherent limnological factors characteristic of mid-latitude lentic systems. (Baker-FRC)  
W82-00814

**THE NATURE OF SELECTED PRAIRIE LAKE AND STREAM SEDIMENTS,**  
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.

For primary bibliographic entry see Field 2J.

W82-00815

**GRAZING RATE DETERMINATION OF CORYNONEURA SCUTELLATA WINNERTZ (CHIRONOMIDAE:DIPTERA),**  
Rhode Island Univ., Kingston. Dept. of Zoology. D. H. Kesler.  
Hydrobiologia, Vol 80, No 1, p 63-66, April, 1981. 1 Fig, 10 Ref.

Descriptors: \*Midges, \*Littoral zone, Littoral drift, Lakes, \*Phytoplankton, Aquatic drift, \*Rhode Island, Grazing, Standing crops, Aquatic flora, Aquatic animals, Diptera.

The grazing rate of the larval chironomid *Corynoneura scutellata Winnertz* (Diptera) was investigated. Sampling was carried out in Nonquit Pond, Rhode Island. *C. scutellata* larvae were collected from the littoral zone. Grazing rates were determined radiometrically at different temperatures. The resulting temperature-grazing function is given. This function was then applied to field data from Nonquit Pond. A maximum grazing rate of 107 mg dry weight/square meter/day was calculated to have occurred in late June of 1978. Calculated *C. scutellata* grazing rates were compared to periphyton net accumulation rates. The means of these ratios ranged from 3 to 15% with a maximum of 70%, indicating that these larvae are potentially able to affect periphyton standing crop. (Baker-FRC)  
W82-00822

**NITROGEN AND PHOSPHORUS RECYCLING IN LAKE SAMMAMISH, A TEMPERATE MESOTROPHIC LAKE,**  
Washington Univ., Seattle. Dept. of Civil Engineering.

R. B. Birch, and D. E. Spyridakis.  
Hydrobiologia, Vol 80, No 2, p 129-138, May, 1981. 3 Fig, 3 Tab, 21 Ref.

Descriptors: \*Lakes, \*Nutrients, \*Nitrogen, \*Phosphorus, Mesotrophic lakes, Mesotrophy, Trophic load, Dynamics, \*Cycling nutrients.

Nitrogen and phosphorus budgets are presented for spring and summer for the trophogenic and tropholytic zones of Lake Sammamish. The budgets are constructed to evaluate the efficiency of nutrient recycling and increase knowledge of the overall nutrient dynamics. The budgets reveal that uptake and solubilization are the dominant fluxes and that nutrient recycling is generally efficient with the possible exception of early spring during the diatom bloom. Solubilization of particulates is much less in the tropholytic zone than the trophogenic zone. This is due to slower decomposition rates there and to the efficiency of solubilization in the overlying trophogenic zone which results in a relatively small particulate influx. Turnover times for the N and P pools are thus much faster in the trophogenic zone than in the tropholytic zone. In the trophogenic zone, however, the dissolved N pool turns over much more slowly than the dissolved P pool due to its larger size relative to algal

## Field 2—WATER CYCLE

### Group 2H—Lakes

growth requirements. Overall there is a net loss of N and P from the water column in spring, primarily due to sedimentation and denitrification, while in summer there is a small net gain due to sediment release and a slight excess of inflow over outflow. (Baker-FRC)  
W82-00824

#### POTENTIAL IMPACT OF SIZE-SELECTIVE PLANKTIVORY ON PHOSPHORUS RELEASE BY ZOOPLANKTON, Wisconsin Univ.-Madison.

S. M. Bartell.  
*Hydrobiologia*, Vol. 80, No. 2, p 139-145, May, 1981. 5 Tab, 28 Ref.

Descriptors: \*Zooplankton, \*Phosphorus, Lakes, Nutrients, Cycling nutrients, \*Predation, Fish.

The speculation that size-selective predation by planktivorous fishes affects rates of phosphorus release by zooplankton at the system level through changes in both mean individual size and biomass of zooplankton was investigated. Comparisons were made of estimated rates of P release from zooplankton in lakes before and after introduction of size-selective predators, and comparisons were made among several lakes with varying abundance of predators. A laboratory model of phosphorus release by *Daphnia* was implemented for published zooplankton data from the lakes. Size-selective feeding reduced average prey size and increased P release per unit biomass. At the system level, decreased prey standing crop associated with higher planktivore abundance could balance the size dependent increase in P release rate. However, estimates of both net reduction and net increase in rate of P release from zooplankton resulted from model application. Size-selective feeding may be important not only in energetic or evolutionary relationships between predator and prey but also in determination of the relative importance of different pathways of phosphorus flow through pelagic systems. (Baker-FRC)  
W82-00825

#### ON LAKE BOTTOM DYNAMICS—THE ENERGY-TOPOGRAPHY FACTOR, National Swedish Environment Protection Board, Uppsala Water Quality Lab.

L. Hakanson.  
*Canadian Journal of Earth Sciences*, Vol. 18, No. 5, p 899-909, May, 1981. 4 Fig, 10 Tab, 13 Ref.

Descriptors: \*Lakes, \*Bottom sediments, Erosion, Mathematical models, Models, Mathematical studies, Lake morphology, \*Limnology, Lake sediments, Sediments, Lake shores, Lake basins, Dynamics, Basins.

Some of the causal relationships that determine bottom dynamics in lakes are discussed, and a formula is suggested that expresses these causal relationships in terms of simple morphometric parameters. The benefit of such a model is that much valuable information can be gained from a minimum of work. Detailed empirical data from areas dominated by erosion, transportation, and accumulation have been determined for nine Swedish lakes or basins. The model has been calibrated against this set of data. The areal distribution of lake bottom areas dominated by erosion and transportation is governed by an energy factor, a slope factor, and a form factor. The equation which interrelates these factors is presented. Despite the fact that the formula is based on only three morphometrical standard parameters, it yields a surprisingly high correlation, which indicates that it describes the functional relationships in a proper manner. Tests have indicated that this formula is not significantly improved by accounting for the shore irregularity and lake shape factors. It is probable that the model yields the most accurate results for lakes in the size range of 1 to 5000 square kilometers. It is only applicable to single basins. In multi-basin lakes each basin must be treated separately. (Baker-FRC)  
W82-00837

#### SEDIMENT-BASED NUTRITION OF SUBMERGED MACROPHYTES,

Army Waterways Experiment Station, Vicksburg, MS.  
J. W. Barko, and R. M. Smart.  
*Aquatic Botany*, Vol. 10, No. 4, p 339-352, May 1981. 7 Tab, 48 Ref.

Descriptors: \*Macrophytes, \*Nutrients, \*Sediments, Nitrogen, Phosphorus, Potassium, Uptake, Lakes, Plant growth, Vegetation, \*Rooted aquatic plants.

An evaluation was made of the abilities of four submersed freshwater macrophytes to mobilize nitrogen, phosphorus, and potassium from different sediments in relation to their respective requirements for these nutrients. The four species involved were *Bacopa caroliniana* (Walt.) Robbins, *Myriophyllum brasiliense* Camb., *Potamogeton illinoiensis* Morong, and *Proserpinaca palustris* L. With all species, N and P were readily mobilized in plant shoots at levels well above those required for growth. However, the mobilization of K from all sediments was far less effective and may have limited the growth of the species considered. Sediments represent a large and important source of N and P for rooted aquatic macrophytes, but K is probably supplied to these plants primarily from the water. N and P were excreted in only small amounts, if at all, from the species during active growth. However, considerable quantities of these nutrients can be released to the water due to plant senescence and associated decay. This represents an important mode of sediment-nutrient recycling in aquatic systems. (Baker-FRC)  
W82-00843

#### ABSORPTION OF FENITROTHION BY PLANKTON AND BENTHIC ALGAE, Moncton Univ., (New Brunswick).

For primary bibliographic entry see Field 5B.  
W82-00874

#### MERCURY AND SELENIUM CONCENTRATIONS IN FISH, SEDIMENTS, AND WATER OF TWO NORTHWESTERN QUEBEC LAKES, Noranda Research Centre, Pointe Claire (Quebec). Process Technology Dept.

For primary bibliographic entry see Field 5B.  
W82-00876

#### AMMONIA AND NITRATE UPTAKE IN THE LOWER GREAT LAKES,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.

T. P. Murphy.  
*Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 37, No. 9, p 1365-1372, September, 1980. 7 Fig, 1 Tab, 26 Ref.

Descriptors: \*Lakes, \*Primary productivity, \*Nitrogen, \*Limiting nutrients, Spectrophotometry, \*Ammonia, \*Great Lakes, Water analysis, Nutrients, Nitrate, Cycling nutrients, Data collections, Incubation, Lake Erie, Lake Ontario.

A simple radiolabeled N technique of emission spectrophotometry has been used to obtain a large data base for nitrate and ammonia uptake kinetics in Great Lakes Erie and Ontario. Short-term incubation of water samples was necessary to prevent induction of nitrate uptake or changes in the rate of ammonium ion uptake which took place in long-term incubations. During most of the summer, uptake rates of nitrate and nitrate regeneration rates were generally slow. The slow turnover rate of particulate N, low levels of nutrients, and high affinities for ammonia suggest that the summertime primary productivity of the Lower Great Lakes is limited by nitrogen concentrations. (Geiger-FRC)  
W82-00882

#### LIMNOLOGICAL CHARACTERISTICS OF SEVERAL LAKES ON THE LAKE WALES RIDGE, SOUTH-CENTRAL FLORIDA, Bucknell Univ., Lewisburg, PA. Dept. of Biology.

W. F. McDowell.  
*Hydrobiologia*, Vol. 71, No. 1/2, p 137-145, May, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: \*Nutrients, \*Primary productivity, \*Water quality, \*Productivity, \*Lakes, Eutrophication, \*Florida. Phytoplankton, Nitrogen compounds, Phosphorus compounds, Limnology, Watershed development, Chlorophyll a.

Three lakes in southcentral Florida were studied from September 1976 to July 1977 to obtain basic limnological information, focusing on the productivity and nutrient relationships as affected by human activity. The lakes—Annie, Placid, and Francis—are connected seasonally by either natural drainage or man-made canals. Lake Annie is underdeveloped; the other two are partly to completely developed. All three lakes have clear, soft, nutrient-poor water. Primary production and chlorophyll a production is highest in Lake Francis. Productivity estimates (in g carbon per sq meter per year) were 205 for Francis, 75.8 for Annie, and 42.8 for Placid. Water from all three lakes responded to enrichment with N and P, but none to N alone. Lake Francis responded to P addition alone. Francis was judged nearly eutrophic, and the other two lakes oligotrophic in terms of primary productivity, light transmission, and dominant phytoplankton, and mesotrophic in terms of chlorophyll a. The water quality of these lakes appeared to be correlated with development along the shoreline and use of the surrounding watershed. (Cassar-FRC)  
W82-00914

#### FACTORS CONTROLLING PHYTOPLANKTON PRIMARY PRODUCTIVITY IN BYRAM LAKE, MT. KISCO, N.Y., SUMMER, 1977, Fordham Univ., Bronx, New York. Louis Calder Conservation and Ecology Study Center.

G. S. Kleppel, R. Ingram, and W. B. Samuels.  
*Hydrobiologia*, Vol. 70, No. 1/2, p 95-101, April, 1980. 3 Fig, 2 Tab, 23 Ref.

Descriptors: \*Primary productivity, \*Eutrophic lakes, \*Water depth, Stratification, Algae, Phytoplankton, Productivity, Eutrophication, Lakes, \*Byram Lake, New York.

Accelerated eutrophication and algal blooms in Byram Lake, New York, prompted an investigation of phytoplankton productivity. Results suggest that horizontal and vertical microenvironments exist throughout the lake. At deeper stations, thermal stratification placed inorganic nitrogen in juxtaposition with phytoplankton in the upper metalimnon. At one station, surface productivity was ammonia-limited and bottom productivity was related to P levels. Phytoplankton productivity at a shallow station was inversely related to incident light and temperature. The vascular macrophyte bloom shaded the phytoplankton and decreased its productivity. In late summer the macrophytes decayed and released nutrients. As a result phytoplankton productivity reached a maximum in September. The failure to detect relationships between depth integrated productivity and environmental parameters suggests that the controlling factors were not measured in this study, that multiple parameter interactions regulated productivity, or that different factors were significant at different depths. (Cassar-FRC)  
W82-00915

#### CHEMICAL COMPOSITION OF LABILE FRACTIONS IN DOM, Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.

M. Ochiai, T. Nakajima, and T. Hanya.  
*Hydrobiologia*, Vol. 71, No. 1/2, p 95-97, May, 1980. 2 Fig, 2 Tab, 8 Ref.

Descriptors: \*Organic matter, \*Amino acids, \*Carbohydrates, Degradation, Microbial degradation, Labile fraction, Dissolved solids, Organic carbon, \*Chemical composition, Natural waters, Lakes, Decomposition, Lake Nakanuma, \*Japan, \*Dissolved organic matter.

The labile fraction (biologically derived compounds such as carbohydrates, proteins, amino acids, and lipids) of dissolved organic matter (DOM) in an eutrophic lake was decomposed under anaerobic and aerobic conditions for 20 days. In

## WATER CYCLE—Field 2

### Lakes—Group 2H

aerobic decomposition total dissolved organic carbon decreased by 20% (initial concentration 4.19 mg C per liter), dissolved amino acids by 15% (initial concentration 0.49 mg C per liter), and dissolved carbohydrates by 48% (initial concentration 0.43 mg C per liter). In aerobic experiments with the same starting concentration, total dissolved organic C decreased by 26%, dissolved amino acids by 23%, and dissolved carbohydrates by 53%. These results show that the dissolved amino acids and dissolved carbohydrate fractions were preferentially decomposed compared with other fractions and are confirmed to be the labile fractions of dissolved organic matter. (Cassar-FRC) W82-00917

#### THE USE OF ALGAL ASSAYS AND CHLOROPHYLL CONCENTRATIONS TO DETERMINE FERTILITY OF WATER IN SMALL IMPOUNDMENTS IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Biology.

J. Davis, and J. Decosta.

Hydrobiologia, Vol 71, No 1/2, p 19-34, May, 1980. 14 Fig, 7 Tab, 26 Ref.

Descriptors: \*Phosphorus, \*Algae, \*Fertility, Eutrophic lakes, Lakes, Artificial lakes, Reservoirs, \*West Virginia, Chlorophyll, \*Nutrients, Nitrates, Phytoplankton, Eutrophication, Selenastrum capricornutum, Trophic level, Productivity, Phosphorus.

Phosphorus was the limiting nutrient in seven small artificial lakes in West Virginia, according to 21-day algal assay tests with *Selenastrum capricornutum*. In every case the water was fertile enough for algae to grow well without additional nutrients. All lakes were classified mesotrophic to slightly eutrophic. Sampling was done from December 20, 1975, to October 17, 1976, once each during the spring and fall isothermal periods and biweekly during summer stratification. Total phosphate-P (in micrograms per liter) ranged from 8.1 to 16.2 in spring, 2.18 to 69.9 in summer, and 8.4 to 29.4 in fall. Nitrate-N (in mg per liter) ranged from 0.038 to 0.720 in spring, 0 to 0.370 in summer, and 0.008 to 0.170 in fall. Uncorrected chlorophyll a values (in micrograms per liter) were 1.7 to 61.4 in spring, 4.3 to 232.0 in summer, and 4.5 to 24.5 in fall. (Cassar-FRC) W82-00919

#### INORGANIC TRANSFORMATION OF APPLIED PHOSPHORUS IN BRACKISH WATER FISH POND SOIL UNDER DIFFERENT WATER SALINITY LEVELS,

Central Inland Fisheries Research Inst., Barrackpore (India).

G. N. Chaitopadhyay, and L. N. Mandal.

Hydrobiologia, Vol 71, No 1/2, p 125-130, May, 1980. 6 Tab, 12 Ref.

Descriptors: \*Phosphorus, \*Fish ponds, \*Salinity, Chemical reactions, Organic matter, Phosphates, \*Brackish water, Ponds, Nutrients, Fertilizers, Aquatic soils.

Transformation of phosphorus, applied as 0 or 100 ppm KH<sub>2</sub>PO<sub>4</sub>, to brackish water fish pond soil was studied at different salinity levels (trace, 10, 20, and 30 ppt) and in the presence and absence of organic matter, a P-free starch. Added P disappeared rapidly from the water phase. For example, without added organic matter and at trace salinity, 44.40 ppm P present in the water phase on the tenth day of incubation decreased to 16.2 ppm on day 100; at 30 ppt salinity, 58.90 ppm P decreased to 13.80 ppm by day 100. Increases in water salinity produced increases in amount of salid-bound P and decreases in Bray's No. 2 extractable form P. The transformation product in highest concentration was calcium phosphate, especially in more saline water. Lesser amounts of iron phosphate and aluminum phosphate were formed. Addition of organic matter did not affect the transformation of P into calcium phosphate but reduced fixation into the iron phosphate form, increasing the availability of P in water and soil phases. These results suggest that a more effective method of adding P to brack-

ish water ponds would be split doses in combination with organic matter. (Cassar-FRC) W82-00920

#### INFLUENCE OF PHOSPHORUS LOADS AND OF SOME LIMNOLOGICAL PROCESSES ON THE PURITY OF LAKE WATER,

Polish Academy of Science, Warsaw. Inst. of Ecology.

Z. Kajak.

Hydrobiologia, Vol 72, No 1/2, p 43-50, July, 1980. 8 Tab, 68 Ref.

Descriptors: \*Phosphorus compounds, \*Nutrients, \*Water quality, \*Lakes, Cycling nutrients, Nitrogen compounds, Fish, Agriculture, Eutrophication, Aquatic life, Zooplankton, Limnology, Phytoplankton, Algae, Surface water, Lake sediments, Sediments, Sedimentation, Biomass, Seston, Reviews.

The problem of the relationship between nutrient loads and phytoplankton biomass is reviewed with special emphasis on phosphorus. Total P concentrations in pollution sources vary from 1000 mg per liter in animal waste slurries to 0.01-0.1 mg per liter from atmospheric precipitation and natural forest and meadow runoff. Surface nonpoint outflow from towns and runoff from bare soil contribute the most P to surface waters. The contribution of agriculture to eutrophication becomes proportionally more important as more facilities remove P from sewage in tertiary treatment. P in lake water is removed by retention in the sediment, but returns again to the epilimnia through water circulation and recycling by algae and other organisms. Fish affect nutrient concentrations by stirring up bottom sediments, eliminating sedimenting feces, releasing nutrients by metabolism, changing the species composition, intensifying the decomposition process, and changing light conditions. In fish ponds with common carp, the addition of silver carp increases the phytoplankton biomass and the rate of P sedimentation and decreases the amount of P released by the zooplankton. (Cassar-FRC) W82-00923

#### SIMULATION OF LAKE-WATERSHED SYSTEMS, I. DESCRIPTION AND SENSITIVITY ANALYSIS OF THE MODEL,

Alberta Univ., Edmonton. Dept. of Geology.

For primary bibliographic entry see Field 2A.

W82-00926

#### SIMULATION OF LAKE-WATERSHED SYSTEMS, II. APPLICATION TO BAPTISTE LAKE, ALBERTA, CANADA,

Alberta Univ., Edmonton. Dept. of Geology.

For primary bibliographic entry see Field 2A.

W82-00927

#### PREDICTION OF PHOSPHORUS AND NITROGEN CONCENTRATIONS IN LAKES FROM BOTH INTERNAL AND EXTERNAL LOADING RATES,

University of East Anglia, Norwich (England).

School of Environmental Sciences.

P. L. Osborne.

Hydrobiologia, Vol 69, No 3, p 229-233, March, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: \*Lake restoration, \*Phosphorus compounds, \*Nitrogen compounds, Lakes, Nutrients, \*Eutrophic lakes, Model studies, Seasonal variation, Prediction, Loading rates.

A variation of the Vollenweider model predicting phosphorus and nitrogen concentrations from loading rates was tested with data from a shallow, eutrophic lake, Barton Broad, 70 ha in area and 1 meter deep. Both external and internal loading occurred. Predicted and observed concentrations of P and N in the outflow were similar. Splitting the year into seasons overcame the problem of fluctuations in P and N loading rates (nutrient inputs from land drainage were higher in winter, and internal loading occurred in summer). The model can be used to predict the reduction in

loading rate required either to limit phytoplankton population and improve water quality or to determine the nutrient concentrations suitable for establishing submerged macrophytes. (Cassar-FRC) W82-00928

#### PHOSPHATE MODELS, A GAP TO BRIDGE,

Station Biologique de la Tour du Valat, Arles (France).

H. L. Golterman.

Hydrobiologia, Vol 72, No 1/2, p 61-71, July, 1980. 1 Fig, 3 Tab, 31 Ref.

Descriptors: \*Model studies, \*Phosphates, \*Phytoplankton, Statistical models, Conceptual models, Nutrients, Lakes, Sedimentation, Adsorption, Productivity, Prediction, Loading rates.

Models for predicting phytoplankton productivity as a function of phosphate loading are necessary for water management. This paper discusses the differences between statistical models and dynamic or conceptual models and makes suggestions for bridging the gap between the two. In statistical models, formulas described the relationships between the P-loading and P-concentrations based on the statistical analysis of data derived from a population of lakes. In conceptual models, processes concerning P-dynamics are measured and formulas developed to describe these processes. The constants are then adjusted iteratively to achieve best fit. Conceptual models are difficult to extend to lakes other than those for which they were developed. The easier way to bring the two types of models closer together is to have correct statistical data on total sediment load, water hardness, productivity, rainfall, and other parameters. Then conceptual models can be used for sensitivity analysis and to provide information for further analysis of statistical models. Models based on fluxes have the greatest predictive value and make it easier to apply data from one lake to another. (Cassar-FRC) W82-00929

#### REVIVING ACIDIFIED LAKES,

Uppsala Univ. (Sweden). Dept. of Limnology.

W. Rohde.

Ambio, Vol 10, No 4, p 195-196, 1981. 1 Fig, 8 Ref.

Descriptors: \*Lake restoration, \*Acidic water, \*Neutralization, Rehabilitation, Lakes, Acidity, Acid rain, Algae, Bacteria, Water pollution effects, Water pollution treatment, \*Sweden, Hydrogen ion concentration, Calcium carbonate.

The progressive acidification of lakes can be somewhat counteracted by the addition of neutralizing materials, but even very acid bodies of water are objects of natural colonization within a short time. Sweden has treated about 1000 lakes by adding calcium carbonate or other neutralizing materials, but the treatment is expensive and must be repeated. When the pH reaches 4 or 5, almost none of the original organisms are able to survive. Japan's volcanic lakes with pH's of 2-5 have existed long enough for acid-tolerant and acidophilic organisms to become established. These lakes include bacteria, fungi, algae, animals, macrophytes, and one species of fish. Thus, water devoid of life is the object of colonization, and research should be undertaken to determine the best autotrophic algae to introduce as pioneers. From naturally acid waters, plankton and benthic algae could be collected and studied, and eventually used to inoculate large bodies of water. At present, the only alternative is to apply neutralizing agents. (Small-FRC) W82-00933

#### METHANE FORMATION IN THE ACID PEATS OF OKEFENOKEE SWAMP, GEORGIA,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.

G. A. King, T. Berman, and W. J. Wiebe.

American Midland Naturalist, Vol 105, No 2, p 386-389, April, 1981. 2 Tab, 14 Ref.

Descriptors: \*Methane, \*Swamps, Methane bacteria, Peat, Peat bogs, Peat soils, Muck soils, Organic soils, Acidity, Acidic soils, \*Okefenokee Swamp, Georgia.

## Field 2—WATER CYCLE

### Group 2H—Lakes

Gas bubbles were collected at several sites in the Okefenokee Swamp in Georgia. Rates of methane production in peat samples were determined by first obtaining cores from the various Coot Lake and Grant Prairie sites with 4-inch OD Plexiglas coring tubes. Analysis of the gas bubbles suggests that methanogenesis does occur in the swamp despite the low pH. No apparent trend for lesser amounts of methane was evident among samples from sites with low pH at Coot Lakes vs. the sites with higher pH at Lake Louise and Grassy Pond. The high content of methane in bubbles relative to carbon dioxide and the lesser solubility of methane indicates that bubbles in Okefenokee peat originate from a methane nucleus. In vitro studies revealed substantial rates of methane production. This production in the swamp could result in the formation of a major habitat, the floating peat batteries, and may be a significant source of methane to the atmosphere. A cycle of sinking-floating batteries controlled by bacterial activity may exist in the peat batteries of the swamp. (Baker-FRC)  
W82-00936

#### MEAN SUMMER CIRCULATION IN LAKE ONTARIO WITHIN THE COASTAL ZONE, Woods Hole Oceanographic Institution, MA.

G. T. Csanady, and J. T. Scott.  
Journal of Geophysical Research, Vol 85, No C5, p 2797-2812, May, 1980. 8 Fig, 1 Tab, 21 Ref.

Descriptors: \*Water circulation, Lakes, \*Coastal waters, Lake shores, Flow characteristics, Flow profiles, Mathematical models, \*Lake Ontario.

The mean flow pattern was observed in the well-resolved coastal zone of Lake Ontario during the summer (July 15 through August 15) of 1972. Detailed velocity and temperature profiles were used to define the summer circulation pattern. Simple equilibrium models of wind-driven flow were used to explain some of the features of the flow pattern. South shore mean currents behaved remarkably like the simple theoretical model of steady wind-driven flow in a two layer basin. North shore mean flow was completely different and lacked coastal jets. This was probably due to momentum (and heat) advection during full upwelling episodes. Thus, the south shore current pattern consisted of divergent coastal jets, the eastern shore had a deep current generated by interface friction below the strong coastal jets, and the northern shore return flow of warm water was probably accomplished at some distance offshore. (Small-FRC)  
W82-00967

#### THE EFFECT OF CHANGES IN THE NUTRIENT INCOME ON THE CONDITION OF LAKE WASHINGTON, Washington Univ., Seattle. Dept. of Zoology.

W. T. Edmondson, and J. T. Lehman.  
Limnology and Oceanography, Vol 26, No 1, p 1-29, January, 1981. 13 Fig, 11 Tab, 55 Ref.

Descriptors: \*Phosphorus, \*Nitrogen, \*Eutrophic lakes, \*Nutrients, Lakes, Lake sediments, Seasonal variation, Water pollution, Wastewater disposal, Eutrophication, \*Lake Washington, Washington.

Variations in nutrient income resulting from alterations in sewerage arrangements have had a significant effect on the condition of Lake Washington. Between 1941 and 1963, the lake received increasing amounts of secondary sewage effluent from the Seattle, Washington, metropolitan area, with resultant changes in the amount of nutrients in the water and in the kind and quantity of phytoplankton. The lake responded quickly to declining inputs of effluent between 1963 and 1968, when almost all discharges to the lake were discontinued. The amount of nutrients, the quantity of phytoplankton, and the proportion of blue-green algae all decreased during this period. By 1975, the lake could be regarded as having recovered from eutrophication. Calculations of phosphorus and nitrogen income sewage to the lake had much more effect on the phosphorus regime than on the nitrogen regime. Total phosphorus input varied from a high of 204,200 kilograms per year in 1964 to a low of

42,900 in 1973 and 1976, with sewage contributing about 72 percent of the total in 1962. Variation in total nitrogen ranged from a high of 1,419,000 kilograms per year in 1964 to 734,000 in 1976. Seasonal differences were found in the deposition of phosphorus to and release from the sediments. On the average, the sediments retained about 57 percent of the income over the long term. After diversion of the sewage effluent from the lake, there was a slight increase in the proportion of incoming phosphorus lost to the sediments. The amount of phosphorus lost permanently to the sediments during a year was found to be more closely related to the annual income than to the mean concentration in water. (Carroll-FRC)  
W82-00987

#### EXPERIMENTAL MANIPULATION OF ALGAL BLOOM COMPOSITION BY NITROGEN ADDITION,

Department of Fisheries and Oceans, Winnipeg (Manitoba).

For primary bibliographic entry see Field 5C.  
W82-00998

#### HEAVY METAL CONTENTS IN SOME MACROPHYTES FROM SAGINAW BAY (LAKE HURON, U.S.A.),

Cranbrook Inst. of Science, Bloomfield Hills, MI.

For primary bibliographic entry see Field 5B.  
W82-01000

#### A METHOD FOR THE EVALUATION OF CONDITIONS IN A FISH POND SEDIMENT,

Science and Education Administration, Duran, OK. Southern Plains Watershed and Water Quality Lab.

Y. Avnimelech, M. Lacher, A. Raveh, and O. Zur. Aquaculture, Vol 23, No 1-4, p 361-365, April 1981. 2 Tab, 6 Ref.

Descriptors: \*Bottom sediments, \*Fish ponds, \*Ecosystems, Phosphorus, Sediments, Organic matter, Fish, Decomposing organic matter, Anaerobic conditions, Measurement techniques.

Intensive fish farms are known to suffer significant decreases in fish growth and increases in the yield coefficient over time. This decline in fish pond fertility with time appears to result from excessive and rapid accumulation of organic carbon and nitrogen compounds in the fish pond sediment, which can cause a reduction in the oxidation potential. Although the rate of fish growth is commonly used to evaluate conditions in the fish pond, it is hard to relate fish growth to the conditions in the sediment at a given time using this method. A method for measuring fish grazing in the sediment has been developed to assist evaluation of the overall conditions in the sediments at a given time. The method involves measuring the extent of grazing of fish at the sediment by counting the phosphorus-32 tagged mud in the digestive tract of fish. The method was tested using two types of sediments (fresh soil and soil which had previously been used in intensive aquaculture systems for about 100 days) and three treatments with nutrient pellets (none, 60 grams, and 100 grams). In the control experiments, nets prevented the fish from grazing. Analysis of the uptake of the tagged mud by the fish showed that the uptake of phosphorus-32 by fish in containers with fresh soil without added nutrients was only slightly higher than the uptake of the tagged mud in the control treatment, which was not negligible. Fish in containers with fresh soil enriched with nutrients had the highest phosphorus-32 uptake. Fish in containers with enriched aged fish pond sediments, which were overloaded and anaerobic, showed phosphorus-32 uptake which were about one third less than those in the enriched fresh soil. This method is shown to yield consistent results which are in agreement with previous experiences and observations of the fish growth in intensive ponds. (Carroll-FRC)  
W82-01019

#### THE EFFECT OF CONTINUOUS ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE ON THE TROPHIC STATUS OF LONG LAKE, WA DURING 1979,

Eastern Washington Univ., Cheney. Dept. of Biology.

State of Washington Department of Ecology, Olympia, Document DOE 80-11, October, 1980, 86 p. 18 Fig, 25 Tab, 34 Ref.

Descriptors: \*Mesotrophic lakes, Mesotrophy, \*Trophic level, \*Lakes, Water quality management, \*Wastewater treatment, Phosphorus removal, Chlorophyll A, On-site data collections, Hydrologic data collections, Phytoplankton, Phosphates, Water quality, \*Long Lake, Reservoirs, Spokane River, \*Washington.

The water quality of Long Lake, an impoundment of the Spokane River, was documented in a study conducted during the second year of operation of an advance wastewater treatment facility (AWT) built by the City of Spokane in 1977. Long Lake was found to exhibit mesotrophy, as it had in a study conducted in 1978. Phosphorus removal from the sewage effluent resulted in significantly lower phosphate loads to the reservoir than before the AWT was implemented. Phytoplankton biovolumes were also reduced. Correlations showed that chlorophyll A concentrations gave a reasonable estimate of phytoplankton standing crop. In addition, areal phosphorus loading gave an excellent estimate of mean chlorophyll A concentration. The successional patterns of the major zooplankters were similar to those observed in 1978 and prior to the AWT. Zooplankton standing crops were less dense than those determined before the AWT, possibly the result of decreased food availability. Analysis of variance and least significant difference statistical evaluation showed that mean daily total and orthophosphate loads in 1979 at the AWT sewage effluent (S.E.) sampling station were significantly lower than those prior to AWT, but not from those determined in 1978. The sewage outfall effected an increase of total inorganic nitrogen and orthophosphate concentrations in the river of 1.6 and 2.5 times, respectively. (Garrison-Omniplan) W82-01070

#### AN ASSESSMENT OF THE TROPHIC STATUS OF DEER, LOON, AND DIAMOND LAKES,

Washington State Dept. of Ecology, Olympia.

L. Singleton, J. Thielen, and D. Kruger. Document DOE 80-9, July 1980. 33 p. 13 Fig, 12 Tab, 26 Ref, 3 Append.

Descriptors: \*Trophic level, Mesotrophy, \*Lakes, \*Mesotrophic lakes, \*Water pollution effects, Pollution effects, Eutrophication, Oxygen depletion, Water quality, Water quality standards, Data collection, On-site data collections, Hydrologic data collections, Deer Lake, Loon Lake, Diamond Lake, \*Washington.

The trophic status of Deer, Loon, and Diamond Lakes, located north of Spokane, Washington, was evaluated during the 1978 growing season. Sampling occurred bi-weekly from May to November. Historical data were also utilized to determine if water quality had changed in any of the lakes. The results indicated that all three lakes are mesotrophic, each having nutrient and chlorophyll A concentrations below the levels established for eutrophic waters. All three lakes experience some degree of hypolimnetic anoxia, with Loon Lake the most anoxic. Deer Lake has the fewest water quality problems of the three, and the least amount of hypolimnetic oxygen depletion. Deer Lake appears able to sustain its present trophic condition longest and therefore should probably be the last of the three lakes to be affected. Diamond and Loon Lakes both have some water quality problems which indicate they are not as stable. Loon Lake showed a significant decrease in water clarity and a significant decrease in the mean secchi disk depth. The anoxia observed in Diamond Lake was not as severe as in Loon Lake; however, it is still noteworthy. The water quality of Diamond Lake appears to be spatially affected by sludge beds present from previous log rafting practices. The sewerage of Loon and Diamond Lakes needs further evaluation utilizing current demographic and land usage trends present at each lake. Conditions seem to have changed little since the DOE study in 1973; another study is recommended for 1983. (Garrison-Omniplan) W82-01072

## Water In Plants—Group 2I

**GONAD DEVELOPMENT, FECUNDITY, AND SPAWNING SEASON OF LARGEMOUTH BASS IN NEWLY IMPOUNDED WEST POINT RESERVOIR, ALABAMA-GEORGIA,**  
Alabama Cooperative Fishery Research Unit, Auburn.  
T. J. Timmons, W. L. Shelton, and W. D. Davies.  
Technical Papers of the U.S. Fish and Wildlife Service. No 100, 1980. 8 p. 2 Fig, 2 Tab, 28 Ref.

Descriptors: \*Reservoir fisheries, \*Bass, \*Spawning, \*Seasonal distribution, \*Fish eggs, Fish populations, Fish establishment, Mature growth stage, Environmental effects, \*West Point Reservoir, Alabama, Georgia.

After the filling of a new reservoir provides a large area and volume of water for fish population expansion, largemouth bass usually thrive for the first 3 to 10 years, after which growth rate slows. Little is known about the fecundity and sexual maturity of the early year classes of fast-growing largemouth bass in reservoirs in the southeast. West Point Reservoir, an impoundment of the Chattahoochee River, was impounded in October 1974 and filled to full power pool by May 1975. Because high turbidity precluded observation of nest-building and spawning, the spawning period was determined by observing the frequency distribution of ovarian egg diameters and calculating gonosomatic indices. The percentage of body weight contributed by the ovaries and frequency distributions of ovarian egg diameters were reliable indicators of the spawning season of the largemouth bass in the reservoir in 1977. Spawning began in mid-April and continued until mid-June. Some fish apparently spawned more than once, but no summer or fall spawning was indicated. Individual fecundity, determined by a dry weight method, ranged from 6,232 to 117,241 mature eggs for fish over 300 mm in total length. Eggs matured at a size larger than those described in other studies of largemouth bass. The fast-growing initial year classes (1975 and 1976) of largemouth bass dominated the reproducing population. (Moore-SRC)  
W82-01080

**THE IMPACT OF A NATURAL DRAWDOWN ON THE GROWTH OF FOUR EMERGENT SPECIES IN A PRAIRIE GLACIAL MARSH,**  
Iowa State Univ., Ames. Dept. of Botany and Plant Pathology.

A. G. Van der Valk, and C. B. Davis.  
Aquatic Botany, Vol 9, No 4, p 301-322, December, 1980. 6 Fig, 5 Tab, 20 Ref.

Descriptors: \*Marshes, \*Drawdown, Water level, Drought, \*Aquatic plants, Vegetation, \*Ecological effects, \*Eagle Lake, Iowa.

The impact of a natural drawdown in 1977 on the growth of four dominant emergent species at Eagle Lake, Iowa was investigated. Three of the species (*Scirpus validus* Vahl, *Sparagnum eurycarpum* Engelm. and *Typha glauca* Godr.) dominate the polydominant communities of the cyclic zone of the lake. *S. eurycarpum* and *T. glauca* also grow in monodominant communities in the non-cyclic zone. *Scirpus fluviatilis* Gray is found only in small monodominant stands in the non-cyclic zone. Growth of the three species was severely hampered by the drought. The drought, however, reversed a decline in vigor which had started before the drought in *Scirpus validus* Vahl. The drought enabled this species to exist in the marsh for two more years. The data suggest that periodic drawdowns enable several emergent species to coexist in a community due to their diverse responses to the disturbance. (Baker-FRC)  
W82-01096

## 2I. Water In Plants

**TRANSPERSION, STOMATAL CONDUCTANCE, AND PHOTOSYNTHESIS OF TOMATO PLANTS WITH VARIOUS PROPORTIONS OF ROOT SYSTEM SUPPLIED WITH WATER,**  
Department of Agriculture, Harrow (Ontario).  
C. S. Tan, A. Cornelisse, and B. R. Butterly.

Journal of the American Society for Horticultural Science, Vol 106, No 2, p 147-151, March, 1981. 3 Fig, 4 Tab, 14 Ref.

Descriptors: \*Tomatoes, \*Root development, \*Irrigation requirements, Plant growth, Water requirements, \*Transpiration, Photosynthesis, Stomatal transpiration, Soil moisture, Water conservation, Agriculture, Water stress, Soil water.

Tomato (*Lycopersicon esculentum* Mill.) plants were grown in sectional boxes so that each quadrant of the root system could be watered separately. Withholding water from 1 or 2 quadrants did not reduce transpiration, photosynthesis, stomatal conductance, or leaf surface area, suggesting that the absorption capacity of the tomato roots increased in response to the transpiration demand. The shoot:root ratio of the plants increased as the proportions of roots supplied with water increased, 18.4 at 25% watered to 27.9 at 100% watered. Withholding water from 25, 50, and 75% of the root system for two weeks, followed by full watering caused no apparent damage to the root systems in the dry quadrants. Transpiration (1.98-2.45 kg per day), photosynthesis (8.7-10.6 mg per sq dm per hour), and stomatal conductance (0.19-0.24 cm per sec) recovered fully. These results suggest that there is no need to irrigate the entire root system. (Cassar-FRC)  
W82-00504

**WATER RELATIONS OF THREE COWPEA CULTIVARS (VIGNA UNGUICULATA L.),**  
Ibadan Univ. (Nigeria). Dept. of Agronomy.

O. Babalola.  
Plant and Soil, Vol 56, No 1, p 59-69, 1980. 3 Fig, 3 Tab, 14 Ref.

Descriptors: \*Water stress, \*Growth rates, \*Crop yields, Soil water, Roots, Water use efficiency, Evapotranspiration, Cowpea, \*Nigeria, Soil-water plant relationships.

Three cowpea cultivars were investigated to determine the effect of water stress at different growth stages with respect to floral abscission and other growth parameters. Root system development and soil moisture extraction patterns were determined, and water use efficiency under dryland farming was investigated. Soil moisture stress significantly reduced growth and yield (34-46%) of all three. For Ife Brown variety, a semi-erect type, grain yield reduction was highest when stress was imposed at flowering/podding stages. There was no reduction in yield for New Era, a spreading type. Ife Brown was most sensitive to decreased matric potential, and New Era exhibited the highest formal abortion. Evapotranspiration was higher for New Era and Ife Brown than for Adzuki, an erect type. Water use efficiency was highest for New Era and least for Adzuki. New Era may not be suitable for intercropping, but Ife Brown may be popular because its drought susceptibility is intermediate. (Small-FRC)  
W82-00607

**THE EFFECT OF TEMPERATURE ON SALT UPTAKE BY TOMATO PLANTS WITH DIURNAL AND NOCTURNAL WATERLOGGING OF SALINIZED ROOTZONES,**  
Victorian Dept. of Agriculture, Ferntree Gully (Australia). Scoresby Horticultural Research Station.

D. W. West, and J. A. Taylor.  
Plant and Soil, Vol 56, No 1, p 113-121, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: \*Temperature effects, \*Salinity, \*Accumulation, \*Tomatoes, Waterlogging, Root zone, Roots, Sodium chloride, Sodium ions, Chloride ions, Comparison studies.

Tomato plants were grown at three temperatures with the root zones of half the plants waterlogged for the day or night period of each 24 hours. Other plants were grown with drained rootzones, and all plants were irrigated with saline (0.09 M NaCl) nutrient solution. Increase in temperature resulted in increases in leaf Na-ion and Cl-ion concentrations in plants with drained rootzones. In water-

logged plants, the maximum leaf concentration of the ions occurred at 20°C. There were no differences in ion concentrations at 10°C between drained and waterlogged rootzones. Waterlogging of the rootzones resulted in higher concentrations of ions in leaf and stem tissues at 20 and 28°C. No differences were found in the Na and Cl ions in plant tops when plants were waterlogged during the day or night. As temperature increased, transpiration increased, but no other treatment dependent responses were noted. Thus, the direct importance of temperature of growth on the interaction between salinity and waterlogging was demonstrated. (Small-FRC)  
W82-00608

**MOISTURE TRANSPORT IN A SOIL-PLANT SYSTEM: A MATHEMATICAL MODEL AND FINITE ELEMENT ANALYSIS,**  
Weyerhaeuser Co., Centralia, WA.

P. Farnum, and G. F. Carey.  
Advances in Water Resources, Vol 4, No 2, p 67-76, June, 1981. 10 Fig, 1 Tab, 26 Ref.

Descriptors: \*Soil-water-plant relationships, \*Mathematical models, \*Water transport, Plant water potential, Soil water, Evapotranspiration, Finite element method, Mathematical studies.

A comprehensive integrated model was developed for the mathematical analysis of moisture transport from the soil through an individual plant to the atmosphere. The important features associated with non-linear time-dependent diffusion in a non-homogeneous soil are incorporated, including local flow to the individual roots. The flow system is modeled by modeling separate flow subsystems. The model and analysis were used to assess given environmental conditions and to assist in establishing planting guidelines in reforestation. The model's intrinsic value lies in hypothesis testing, including the proposed improvement or elaborations on particular local features. Also, models of the soil-plant system can be incorporated and their effect on the entire system determined. Model predictions compared well with actual experimental results. (Small-FRC)  
W82-00648

**THE EFFECT OF HEIGHT OF WATER TABLE ON THE GROWTH OF HOLCUS LANATUS WITH REFERENCE TO LOLIUM PERENNE,**  
Oxford Univ. (England). Dept. of Agricultural Science.

T. A. Watt, and R. J. Haggard.  
Journal of Applied Ecology, Vol 17, No 2, p 423-430, August, 1980. 6 Fig, 1 Tab, 15 Ref.

Descriptors: \*Soil-water-plant relationships, \*Plant growth, \*Water table, Water level, Soil water table, Experimental data.

Plants of *Holcus lanatus* L. and *Lolium perenne* L. occur frequently in wet sites. They invade sown areas earlier and spread more rapidly on heavy, poorly drained sites. Plants of the two weeds were grown in monocultures and in 50:50 mixtures in free-draining conditions and with water table levels of 5, 11, or 21 centimeters below the soil surface in an effort to determine the effects of depth of the water table on their growth. At the first harvest all three stand types produced the highest yields with the lowest water table, with yields decreasing with increasing height of water table. At subsequent harvest, the free-draining treatment resulted in the highest yields. The absence of significant species times stand type and stand type times water table interactions indicate that there was no difference between the effects of interspecies or intraspecies competition. There was no significant difference between the percentage nitrogen contents of the two grasses in monocultures, with increasing water table height resulting in lower concentrations of nitrogen in both species. While *L. perenne* did not produce surface roots, coverage of the soil surface by surface roots of *H. lanatus* ranged from 15% in free-draining soil to 83% in the high water table treatment. There was also an increase in the number of nodes producing roots in *H. lanatus* with increasing height of water table. These results indicate that adaptations made

## Field 2—WATER CYCLE

### Group 2I—Water In Plants

by the *H. lanatus* plant when growing in soil with a high water table may contribute to their long-term survival at the expense of short-term shoot production. (Carroll-FRC)  
W82-00634

**CONSUMPTIVE USE AND DAILY EVAPOTRANSPIRATION OF CORN UNDER DIFFERENT LEVELS OF NITROGEN AND MOISTURE REGIMES,**  
Andhra Pradesh Agricultural Univ., Hyderabad (India), Dept. of Agronomy.  
For primary bibliographic entry see Field 2D.  
W82-00660

**ANNUAL PLANT PRODUCTION-PRECIPITATION RELATIONS IN ARID AND SEMI-ARID REGIONS,**  
Botanical Research Inst., Pretoria (South Africa).  
M. C. Rutherford.  
South African Journal of Science, Vol 76, No 2, p 53-56, February, 1980. 1 Fig, 35 Ref.

Descriptors: \*Crop production, \*Rainfall rate, Productivity, Precipitation intensity, \*Semiarid lands, \*Arid lands, Semiarid climates, Climates, Water stress, Mathematical studies.

An attempt is made to appraise published relations between annual precipitation and annual plant community production for arid and semi-arid areas. In many cases formulas used are not suitable for these areas. Usually their unsuitability is due to a lack of supporting data or such other reasons as the arbitrary extrapolation of results from short intervals of a growing season over longer periods, the integration of the moisture regime with other important environmental factors, the assumption of linear or identity relations between moisture regime and production, and the limitation of the prediction to only part of the potential plant production. Discussion is given of Walter's relation, in which mean annual precipitation is related to above-ground herbaceous production for semi-arid areas of South West Africa. Discussion is also given to Rosenzweig's and Lieth's relations. The Rosenzweig curve relates annual actual evapotranspiration and above-ground plant production over a much greater range of annual precipitation than Walter's equation. Lieth's Miami Model and the C. W. Thornthwait Memorial Model both predict total production above and below ground. It is concluded that future work in this field would benefit from a clear definition of the term 'production', objective sampling, full presentation of the data, inclusion of other climatic variables to help refine production relations and improve levels of predictability, and adequate testing of available relations before application, with the derivation of new relations where necessary. (Baker-FRC)  
W82-00693

**GROWTH AND NITROGEN FIXATION OF AESCHYNOEMENE UNDER WATER STRESSED CONDITIONS,**  
Florida Univ., Gainesville, Dept. of Agronomy, S. L. Albrecht, J. M. Bennett, and K. H. Quesenberry.  
Plant and Soil, Vol 60, No 2, p 309-315, 1981. 1 Fig, 3 Tab, 23 Ref.

Descriptors: \*Water stress, \*Nitrogen fixation, \*Tropical regions, Waterlogging, Drainage, \*Legumes, Soil properties, Soil porosity, Soil moisture retention, Flooding, Nitrogen, Soil moisture deficiency, Moisture deficiency, Plant growth, \*Aeschynomene, Soil-water-plant relationships.

The tolerance of nitrogen fixation was studied in several accessions of *Aeschynomene americana* in response to various levels of soil moisture. The accessions of *A. americana* were subjected to periods of flooding or soil water deficits to determine stress effects on nitrogen fixation. Cuttings of 22 field grown accessions were rooted in sand and transplanted to a mixture of Wauchula sand, peat and perlite in pots. Nitrogenase activity was determined by the acetylene reduction assay. Both flooding and drought treatments showed increased root weights. The flooding treatment did not sig-

nificantly reduce nodule weight, percent nodulation, or nitrogenase activity, whereas soil moisture deficits caused reductions in these variables. Many of the accessions have effective mechanisms for maintaining active nodules under flooded conditions. Flooded plants maintained leaf water, osmotic and turgor potentials which were similar to those of the well-watered controls. Droughted plants appeared to have much lower nodule water potentials. Flooded plants maintained leaf water relationships which were slightly more favorable than those of the well-watered controls, although the differences were small. It is not known which factors specifically allow waterlogged *A. americana* to fix nitrogen. Accessions which showed good growth and nitrogen fixation under flooding in the greenhouse will be tested on seasonally waterlogged areas to measure performance in the field. (Baker-FRC)  
W82-00758

**WATER DYNAMICS IN THE SOIL-PLANT-ATMOSPHERE SYSTEM,**  
Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab. J. T. Ritchie.  
Plant and Soil, Vol. 58, No. 1-3, p 81-96, 1981. 4 Fig, 34 Ref.

Descriptors: \*Soil-water-plant relationships, \*Agriculture, \*Soil water, \*Crop production, Atmospheric pressure, Transpiration, Mathematical models.

Water dynamics in the soil-plant-atmosphere system are determined by the capacity of the soil water reservoir, its depletion and replenishment, and its efficient management for crop production. Water balance calculations using computers provide a means for accurate estimations of crop yields, early warning about food shortages, and reliable irrigation scheduling and water resource planning. Reliable water balance evaluations depend upon accurate estimation of evaporation from soil and plants. Incomplete crop canopy or a deficiency of water in the root zone may cause a discrepancy between actual evaporation and maximum evaporation. Since it is almost impossible to generalize about plant response to water deficit using soil measurements, attention has been focused on the use of plant measurements for this purpose. Physical measurements sensitive to crop water deficit include plant stomatal resistance and plant water potential. However, both of these measurements are difficult to utilize for operational purposes. Accurate water balance modelling also requires estimation of the amount of water infiltration into the soil from precipitation or irrigation, which can be accomplished using either physical models of hydrologic processes or statistical models fitted to experimental data. (Carroll-FRC)  
W82-00759

**TEMPERATURE AND WATER RELATION PATTERNS IN SUBALPINE UNDERSTORY PLANTS,**  
Wyoming Univ., Laramie. Dept. of Botany. W. K. Smith.  
Oecologia, Vol 48, No 3, p 353-359, 1981. 6 Fig, 1 Tab, 30 Ref.

Descriptors: \*Plant growth, \*Water requirements, Transpiration, Mountains, Cold regions, Water stress, \*Temperature effects, Forests, Rocky Mountains.

A comparison was made of the temperature and water relations of seven understory species that are abundant and grow sympatrically in the understory of the coniferous forests of the Rocky Mountains. Several general characteristics in the water relations of the seven species emerged. Soil moisture remained relatively high throughout the summer even though minimum plant xylem water potentials commonly decreased below minus 1.0 MPa, especially for the more shallow rooted herbaceous species. Leaf temperatures and conductances rose sharply during exposure to sunflecks, along with corresponding increases in transpiration and decreases in xylem water potentials. Midday wilting occurred for four of the seven species, all

of which were herbaceous. Turgor was regained fairly rapidly during subsequent shade periods. Stomata on either leaf surface appeared to remain fully open when oriented away from direct sunlight. The stomatal opening in the morning occurred rapidly for sunlit leaves compared to a more gradual opening for plants in the shade. The amount of incident light on abaxial surfaces was not sufficient to cause full stomatal opening. The study indicated that midday wilting may be a common understory phenomenon within coniferous forests in the Rocky Mountains. Apparently, either water uptake from the soil or water transport from the roots to the leaves was not sufficient to support the transpiration demand for these herbaceous species, in contrast to the two species which were more deeply-rooted, and shrubby in nature. (Baker-FRC)  
W82-00760

**WATER STATUS OF SOIL AND VEGETATION IN A SHORTGRASS STEPPE,**  
Colorado State Univ., Fort Collins. Natural Resource Ecology Lab. O. E. Sala, W. K. Lauenroth, W. J. Parton, and M. J. Trlica.  
Oecologia, Vol 48, No 3, p 327-331, 1981. 6 Fig, 17 Ref.

Descriptors: \*Vegetation, \*Soil water, Moisture stress, Water stress, Water loss, Water supply, Water shortage, Water scarcity, Water deficit, Moisture availability, \*Steppe, North America, Soil-water-plant relationships, Semiarid climates, Plant growth, Available water.

Patterns of water availability were investigated in the semiarid shortgrass steppe region of North America. Specifically, attempts were made to describe the status and transfers of water among the soil-plant-atmosphere compartments during a drying cycle, the pattern of water losses from a completely wet soil profile, and how some physiological plant variables were affected throughout a drying cycle. The study site was on the piedmont or northcentral Colorado at Pawnee Site, about 61 km northeast of Fort Collins. Principal perennial species on the study site were blue grama, fringed sagebrush, plains pricklypear, and needleleaf sedge. Plant and soil water measurements were taken on 15 dates during a 56 day dry cycle. At the beginning of the cycle, water loss occurred exclusively from the top layer. After that the next deeper layer also began contributing water to the total loss. Sixteen days passed before water potential values significantly different from zero were recorded in the 15 cm depth layer. In the deepest layer, 60 cm, water loss began to occur 39 days after the start of the study. Through the first 50 days of plant growth, leaf conductance and water potential at noon slowly declined. After 50 days these levels decreased rapidly. The predawn water leaf potential remained unchanged during the first 45 days, decreasing rapidly thereafter. Predawn leaf water potentials were highly correlated with water potentials of the wettest layer. It appeared that the root surface area limited the water flow through an important part of the day in this semiarid ecosystem. Axial root resistance did not appear significant in determining equilibrium status between leaves and the wettest soil layer. (Baker-FRC)  
W82-00761

**COMPARATIVE FIELD WATER RELATIONS OF FOUR CO-OCCURRING CHAPARRAL SHRUB SPECIES,**  
San Diego State Univ., CA. S. W. Roberts, P. C. Miller, and A. Valamanesh.  
Oecologia, Vol 48, No 3, p 360-363, 1981. 4 Fig, 18 Ref.

Descriptors: \*Water requirements, \*Plant growth, Seasonal variations, \*Chaparral, Shrubs, Water potentials, Drought, Water shortage, Moisture stress, Water stress.

Seasonal water use patterns were investigated in chaparral shrubs using the null-balance approach and evaluating the method with regard to previous measurements of water use patterns in these same shrubs. Field measurements of xylem pressure po-

## WATER CYCLE—Field 2

### Water In Plants—Group 21

tential and leaf conductance were made through a summer drought cycle of *Adenostoma fasciculatum*, *Ceanothus greggii* var. *perplexens*, *Quercus dumosa*, and *Arctostaphylos glauca*, from June through November 1978 at Echo Valley, California. Progressive drought development was noted over the seasonal course of minimum water potential measurements, with a further clear seasonal segregation by species becoming evident. Maximum conductances showed differences between species, and in *A. fasciculatum* there were further differences by leaf age class. No differences in maximum conductances between old and new leaves of *A. glauca* were noted; in general this plant showed the lowest maximum conductances. A peak in October of maximum conductance was noted in association with a short period of precipitation. Diurnal variation of water potential-leaf conductance relations showed large hysteresis early in the season for *A. fasciculatum* leaves on the equator-facing slope. The hysteresis decreased as the drought progressed. These findings suggest that early in the season the water is available to the shrubs and therefore stomatal behavior is largely governed by a complex array of environmental factors. Late in the season, however, stomatal behavior becomes increasingly dominated by tissue water status. (Baker-FRC)

W82-00762

#### THE EFFECT OF ENVIRONMENTAL UNCERTAINTY ON MORPHOLOGICAL DESIGN AND FLUID BALANCE IN *SARRACENIA PURPUREA* L.

Stanford Univ., CA. Dept. of Biological Sciences. J. Kingsolver.

Oecologia, Vol 48, No 3, p 364-370, 1981. 10 Fig.

17 Ref.

Descriptors: \*Water potentials, \*Plant morphology, \*Pitcher plant, Leaves, Evaporation, Precipitation, Drying, Rainfall, Simulation, Model studies.

The morphological design of pitcher plant leaves was considered with respect to their fluid balance in variable environments. Leaves of different sizes and geometries were compared with respect to fluid loss and fluid gain rates. Responses of these different geometries to variations in the hydric environment were analyzed. General design principles were sought in variable and unpredictable environments, with the aim of finding the leaf shape which minimizes the probability that the leaf will lose all of its fluid at any time. The major components of the leaf fluid balance were taken to be precipitation and evaporation, with all other components neglected for the predictions of leaf fluid levels. The temporal distribution of rainfall at the study area is highly non-uniform, with no measurable precipitation occurring on 62% of all days, and with less than 1.0 cm/day falling on 75.5% of the days on which precipitation fell. While no single design criterion can determine the morphology of an organism, it became increasingly clear that continual maintenance of positive fluid balance may be a relevant design criterion for leaf geometry. In terms of both shape and leaf size, the pitcher leaf of *Sarracenia purpurea* is indeed an effective design for reducing desiccation frequency. Desiccation is related not to the mean but to the variation in fluid volume during the season. The pitcher leaf integrates meteorological information over the time period which corresponds closely to the temporal distribution of variation in rainfall. The leaf thus acts as a low-pass filter which selectively removes the high frequency components of rainfall variation. (Baker-FRC)

W82-00811

#### PLANT-WATER RELATIONS AND ADAPTATION TO STRESS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.

N. C. Turner, and J. E. Begg.

Plant and Soil, Vol 58, No 1-3, p 97-131, 1981. 6 Fig, 2 Tab, 180 Ref.

Descriptors: \*Water stress, \*Soil-water-plant relationships, Water deficit, Crop yield, Crop production, Plant morphology, \*Plant growth, Plant

physiology, Soil water, Evaporation, Rainfall, Literature reviews.

Water deficits affect the growth and yield of plants in many ways. While dramatic increases in yields of cereals have been experienced in areas having a regular supply of water assured through rainfall or irrigation, arid and semi-arid regions have experienced much smaller increases over the past 40 years. Improved varieties and higher fertilizer use are not as effective in increasing yields in water-limited environments as they are in more temperate regions or in areas in which irrigation can be provided. Large year-to-year variations in rainfall in Mediterranean-type environments also result in large year-to-year variations in yield per unit area. In order to achieve crop increases in cereal production in semi-arid areas, crops must be designed for adversity, particularly a limited and variable water supply. The development of crop water deficits, and the responses of plants to these deficits, are described. Plants possess a variety of developmental, morphological, and physiological mechanisms which enable them to adapt to water deficits. Rapid phenological development after germination has been widely adopted for crops in semi-arid environments. Developmental plasticity is also highly desirable for crops in these areas. Physiological mechanisms which enable plants to adapt to water stress include seed priming, stomatal control of water loss, osmotic adjustment, and cellular tolerance of dehydration. In order to improve the grain yield of crops in Mediterranean-type environment, it is necessary to increase the water passing through the crop in transpiration, increase the water use efficiency, and/or increase the proportion of total dry matter going to the grain. While the agronomist works to ensure that the most efficient use is made of available water, the breeder must try to produce a cultivar that will give a greater yield under water-limited conditions. (Carroll-FRC)

W82-00812

#### CLONAL VARIATIONS IN THE WATER RELATIONS OF RED OSIER DOGWOOD DURING COLD ACCLIMATION,

Minnesota Univ., St. Paul. Lab. of Plant Hardiness. E. A. Bray, and L. R. Parsons.

Canadian Journal of Plant Science, Vol. 61, No. 2, p 351-363, April, 1981. 8 Fig, 2 Tab, 16 Ref.

Descriptors: \*Cold regions, \*Acclimation, \*Trees, \*Dogwood, Moisture availability, Water use efficiency, Variability.

Studies were made to determine if red osier dogwood acclimating to cold under natural photoperiod and temperature undergoes changes in water relations similar to those demonstrated in plants acclimated in growth chambers and to determine if water relations account for differences in hardiness of several climatic races of red osier dogwood. Cuttings were taken from plants in the University of Minnesota arboretum and field plots. The races of dogwood could be divided into two groups: Oregon, Idaho and Montana varieties became hardy to between -25 and -30 degrees C, and Alaska, North Dakota and Washington varieties became hardy to between -37 and -42 degrees C. After the initial frost, daytime stomatal resistance increased first in the Alaska clone and then in the Washington, Montana and North Dakota clones, but not in Idaho and Oregon clones. The remaining water relations parameters measured did not show differences among the races of dogwood. Stem water content of all clones decreased into mid-October, when they reached a similar water content of about 1 g water/g dry weight. Midday leaf xylem pressure potential of all clones increased during acclimation. Relative water content of the stems decreased during acclimation, but later increased. The water relations parameters of the outdoor acclimation process were very similar to those reported for growth chamber studies. Thus it was concluded that dogwood races from various natural locations acclimated at different rates in a common field location. (Baker-FRC)

W82-00839

#### SEDIMENT-BASED NUTRITION OF SUBMERGED MACROPHYTES,

Army Waterways Experiment Station, Vicksburg, MS.

For primary bibliographic entry see Field 2H. W82-00843

#### SOME ASPECTS OF PLANT WATER RELATIONS IN ALASKAN ARCTIC TUNDRA SPECIES,

San Diego State Univ., CA. S. Oberauer, and P. C. Miller.

Arctic and Alpine Research, Vol. 13, No. 2, p 205-218, May, 1981. 1 Fig, 5 Tab, 21 Ref.

Descriptors: \*Plant water potential, \*Tundra, \*Alaska, \*Arctic, Water potentials, Polar regions, Arctic zone, Cold regions.

Four sites including a snow patch, a south facing slope, a north facing slope, and a tussock tundra ridge were selected for water availability measurements in arctic and alpine tundra. Xylem pressure potentials and interrelations between relative water content, xylem pressure potential, and leaf conductance of several species which are common in tussock and montane tundra were compared at these four Alaskan sites in 1977 and 1978. Evergreen shrubs were found to have the lowest leaf conductances, graminoids and forbs the highest. The relations between relative water content, xylem pressure potential and leaf conductance were not unique to a growth form nor to a vegetation zone. Although different species attained different minimum pressure potentials, individuals of a species showed similar potentials in a variety of sites. The narrow range of minimum potentials of a species and the similar behavior of species within a site indicate strong selection segregating species. (Baker-FRC)

W82-00846

#### WATER STRESS AND COLD HARDINESS IN FIELD-GROWN CITRUS,

Florida Univ., Gainesville. Dept. of Fruit Crops. F. S. Davies, D. W. Buchanan, and J. A. Anderson.

Journal of the American Society for Horticultural Science, Vol. 106, No. 2, p 197-200, March 1981. 2 Fig, 1 Tab, 24 Ref.

Descriptors: \*Citrus fruits, \*Frost protection, \*Irrigation effects, Water stress, Oranges, Fruit crops, Crop yield, Orchards, Trees, \*Florida.

The treatment which permitted the least frost damage in Orlando tagalo (*Citrus reticulata Blanco* x *Citrus paradisi Macf.*) trees was no fall irrigation and under-tree sprinkling during a frost; leaf drop was 11.5% and undamaged fruit, 60%; following a frost in December 1979, in which leaf temperature remained below -3.9C for 8 hours. Trees suffered the worst damage with fall irrigation and no sprinkling during frost. Intermediate damage was allowed by fall irrigation plus frost irrigation and no fall irrigation plus no under-tree sprinkling. Although the soil moisture content of irrigated blocks was significantly greater than for non-irrigated blocks during fall, afternoon leaf xylem water potentials and stem water contents were comparable. (Cassar-FRC)

W82-00864

#### WATER REQUIREMENT FOR SUGARCANE PRODUCTION,

Agricultural Research and Education Center, Belle Glade, FL.

For primary bibliographic entry see Field 3F. W82-00899

#### INVESTIGATIONS OF CONTROL MECHANISMS OF GERMINATION UNDER WATER STRESS,

Department of Agriculture and Fisheries for Scotland, Edinburgh.

T. W. Hegarty, and H. A. Ross. Israeli Journal of Botany, Vol 29, No 1-4, p 83-92, 1980/1981. 2 Fig, 4 Tab, 17 Ref.

Descriptors: \*Water stress, \*Germination, \*Water potentials, \*Plant growth substances, Seeds, Plant

## Field 2—WATER CYCLE

### Group 2I—Water In Plants

growth, Plant physiology, \*Plant water potential, Planting management.

Seedling growth immediately after germination was able to proceed at water potentials lower than those that permitted germination in most varieties of seeds studied. This differential could be reduced by growth regulators, which made the water potential of seed germination more negative. The difference was eliminated by a combination of ethrel and kinetin in red clover and lucerne. Evidence suggests that the process in germination most sensitive to water stress is the initiation of cell elongation. The differential sensitivity to moisture stress is suggested as a form of dormancy. This control mechanism shows variations in operation and response to external stimuli and depends on genetic and environmental factors. (Cassar-FRC) W82-00912

**PHOTOSYNTHESIS AND GROWTH IN POPULATIONS OF *POPULUS DELTOIDES* FROM CONSTRAINING HABITATS,**  
Illinois Univ. at Urbana-Champaign. Dept. of Botany,  
A. B. McGee, M. R. Schmierbach, and F. A. Bezzaz.

American Midland Naturalist, Vol 105, No 2, p 305-311, April, 1981. 4 Fig, 2 Tab, 13 Ref.

Descriptors: \*Plant growth, \*Habitats, Floodplain, Drought, \*Soil types, Transpiration, Trees, Respiration, Photosynthesis, \*Soil-water-plant relationships, \*Populus deltoides.

The degree and expression of ecological differentiation among populations of *Populus deltoides* from three contrasting habitats were examined. The influence of some edaphic conditions upon growth, photosynthesis and transpiration in these populations was investigated. Ramets of floodplain, strip-mine and sand-dune origin were grown in soils of each locality and growth parameters were measured for representative members of each population. The photosynthetic response of flooded and droughted individuals in their native soils was investigated. While the populations were different in some responses, they all accumulated more biomass in the nutrient-rich floodplain soil. Soil type influenced all growth parameters measured, but plant origin influenced only one of these parameters. Photosynthesis declined in all populations when root systems were flooded. This decline was delayed in sand-dune plants until after day 12, due perhaps to their stomatal conductance increasing initially and then declining. Response to drought was different also among the three populations. These findings indicate that *Populus deltoides* grows well across a wide range of soil conditions but exhibited ecological differentiation in the three contrasting habitats it usually occupies. (Bker-FRC) W82-00935

**THE MANIFESTATION OF DEHYDRATION AVOIDANCE IN WHEAT BREEDING GERMPLASM,**  
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Field Crops.  
A. Blum, G. Gozlan, and J. Mayer.  
Crop Science, Vol 21, No 4, p 495-499, July/August, 1981. 3 Fig, 4 Tab, 11 Ref.

Descriptors: \*Wheat, \*Water stress, \*Drought, Crop yield, Crop production, Irrigation effects, Stomata, Plant physiology.

The existence of and variability in dehydration avoidance was investigated within a random sample of advanced and well-adapted wheat. Selected genotypes were planted in each test and two replicate plots. Half of the plots were irrigated every 12 to 17 days, while stress blocks were not irrigated after September 24. Significant variation was found among the 19 genotypes tested in their midleaf water potentials during a stress period. Leaf water potential was correlated with the final number of grains per spike across genotypes of similar phenology in one test where drought stress developed during the spike development stage. Large variations in stomatal response were found,

which indicated that dehydration avoidance in only a few of the genotypes may have resulted from stomatal sensitivity and closure at low stress levels. Most avoidant genotypes had relatively open stomata. Thus, a selection method for dehydration avoidance was investigated which, when combined with other available tests for drought resistance, may lead to the establishment of a logistic breeding program for improved yield and drought resistance in wheat. (Small-FRC) W82-00958

### VEGETATIONAL ANALYSIS OF BIG RUN BOG, A NONGLACIATED SPAGHNUM BOG IN WEST VIRGINIA, West Virginia Univ., Morgantown. Dept. of Biology.

R. K. Wieder, A. M. McCormick, and G. E. Lang. Castanea, Vol 46, No 1, p 16-29, March, 1981. 2 Fig, 2 Tab, 15 Ref.

Descriptors: \*Bogs, \*Vegetation, \*Plant populations, Population density, Spatial distribution, Shrubs, Mosses, Herbs, \*West Virginia, \*Big Run Bog.

Although there have been numerous studies of the vegetation of Sphagnum-dominated bogs and peatlands in glaciated areas and of the vegetation in extensive Sphagnum-dominated areas in nonglaciated regions, the numerous small sized bogs in nonglaciated regions have been largely ignored. The composition and distribution of the vegetation in a small, relatively undisturbed nonglaciated Sphagnum bog in West Virginia was investigated. Vegetation was sampled from late June through early September, 1977, in a series of nested quadrats in Big Run Bog in West Virginia. The following four community types were identified using a minimum variance cluster analysis of the data: Sphagnum-Eriophorum virginicum, Sphagnum-shrub, Polytrichum-shrub, and Polytrichum-Carex canescens. These four community types cover about 85 percent of the surface of the bog, with Sphagnum communities occurring in 122 of the 126 quadrats and Polytrichum occurring in 91 of the quadrats. Vascular herbaceous species cover about 50 percent of the surface of the bog. Upright shrubs are of relatively minor importance, and most of the shrub species are generally found near the edge of the bog. The six tree species were represented by only few individuals, and dead trees and saplings were more numerous than live ones. Several species found in the Big Run Bog have generally boreal distributions but are found at or near the southern limit of their natural ranges in Sphagnum bogs in West Virginia. Marked changes in the composition of bog vegetation have been attributed to alterations of water table level. Frequent alterations of water table level resulting from intermittent beaver habitation may be responsible for the failure of the vegetation to segregate into distinct communities in this bog. The pattern of community distribution may be related to cation concentration of surface water, pH of surface water, and soil moisture, as well as to water table fluctuations. (Carroll-FRC)

W82-00992

### PHOTOSYNTHETIC RECOVERY OF RESURRECTION SPIKEMOSSES FROM DIFFERENT HYDRATION REGIMES, Vanderbilt Univ., Nashville, TN. Dept. of General Biology.

W. G. Eickmeier.  
Ecology, Vol 61, No 3, p 380-385, September, 1980. 5 Fig, 2 Tab, 29 Ref.

Descriptors: \*Desert plants, \*Photosynthesis, \*Drought resistance, Xerophytes, Spikemosses, Mosses, Arid climates, Plant physiology, Humidity, Texas.

The patterns and mechanisms of photosynthetic activity recovery of two resurrection spikemosses were compared in the laboratory. The two plants, found in the southwest Texas desert, were *Selaginella lepidophylla* Hook. and Grev. (hot, arid, low elevation, xeric environment) and *S. pilifera* A. Br. (high elevation, mesic environment). Photosynthetic competence was achieved much more rapidly in

*S. lepidophylla* than in *S. pilifera*. Although chloramphenicol, a chloroplast protein synthesis inhibitor, significantly inhibited resumption of CO<sub>2</sub> uptake in both species, inhibition was greater in *S. pilifera*. The level of conserved ribulose 1,5-bisphosphate carboxylase specific activity was significantly greater in *S. lepidophylla*. These results support the hypothesis that desiccation produces less damage to the photosynthetic system in plants from more xeric environments than in plants from mesic environments. (Cassar-FRC) W82-01010

### SEASONAL PATTERNS OF LEAF WATER RELATIONS IN FOUR CO-OCCURRING FOREST TREE SPECIES: PARAMETERS FROM PRESSURE-VOLUME CURVES, Duke Univ., Durham, NC. Dept. of Botany.

S. W. Roberts, B. R. Strain, and K. R. Knoerr. Ecologia, Vol 61, No 3, p 330-337, September, 1980. 8 Fig, 37 Ref.

Descriptors: Water potentials, \*Drought, \*Leaves, Soil-water-plant relationships, Trees, Osmotic pressure, Plant water potential, Forests, Seasonal variation, \*Forests.

Leaf water relationships were studied in 4 forest tree species (*Ilex opaca* Ait., American holly; *Cornus florida* L., flowering dogwood; *Acer rubrum*, red maple; and *Liriodendron tulipifera* L., tulip poplar) during April-August 1977, a dry summer. Initial osmotic potentials (the value of the osmotic component at full turgidity) were highest at the start of the growing season and decreased as the season progressed. Precipitation after a dry period caused an increase in initial osmotic potentials. All species but *Acer* maintained leaf turgor throughout the season; during the July drought *Acer* leaves lost some turgor at midday. Younger *Acer* leaves had higher early season initial osmotic potentials than overwintering leaves from the same tree. In *Liriodendron* the osmotic potentials of the leaves appeared to be related to the resistance of these leaves to drought conditions. The osmotic water fraction (fraction of total leaf water available to affect osmotic potentials) was greatest in young tissue early in the season and declined throughout the season. The measured water relationships agreed with the relative positions of the species along a water-availability gradient in the order *Cornus* (wettest), *Acer* and *Liriodendron* (intermediate), and *Ilex* (driest). This suggests that these trees coexist in a drought situation because each species uses water maximally at different stages of the water availability cycle. (Cassar-FRC) W82-01011

### DRYLAND CROPPING STRATEGIES FOR EFFICIENT WATER-USE TO CONTROL SALINE SEEPES IN THE NORTHERN GREAT PLAINS, U.S.A.,

Science and Education Administration, Mandan, ND. Northern Great Plains Research Center. For primary bibliographic entry see Field 3F.

W82-01023

### WATER RELATIONS, SOIL FERTILITY, AND PLANT NUTRIENT COMPOSITION OF A PYGMY OAK ECOSYSTEM, Fisheries and Wildlife, Columbia, MO.

P. B. Reich, and T. M. Hinckley. Ecology, Vol 61, No 2, p 400-416, 1980. 11 Fig, 3 Tab, 54 Ref.

Descriptors: \*Water stress, \*Nutrients, \*Forests, \*Ecosystems, Moisture availability, Growth, \*Pygmy oaks, Trees, Soil properties, Seasonal variations, Temperature effects.

A study was conducted to describe the seasonal and spatial patterns of soil-plant moisture and nutrient relations for both a pygmy and a non-pygmy forest; to examine diurnal trends in plant water deficit, leaf conductance, and certain environmental variables; and to describe differences between seedling growth of acorns from pygmy and non-pygmy oaks. The study site was Buzzard's Roost, an unusual pygmy oak ecosystem in southwest Missouri. Pygmy forest soil was very acidic, with

## Erosion and Sedimentation—Group 2J

low levels of calcium and magnesium and high levels of aluminum. Adjacent non-pygmy forests had higher pH, Ca and Mg, and lower Al levels. Diurnal and seasonal patterns of xylem pressure potential, leaf conductance, and soil moisture content illustrated the development of very severe tree water deficits at Buzzard's Roost. Predawn and midday xylem pressure potentials decline to as low as -3610 and -4200 kPa, respectively, accompanied by complete daytime stomatal closure. However, other factors indicated that water stress was not the major factor or causative agent in the stunting process. Very low nutrient levels in the soil may be partly responsible for the existence of the pygmy oak forest. The xeric site characteristics add another severe stress to this ecosystem. The adverse soil factors set up a 'feedback' system in which nutrient loss, acidification, and changing ion solubilities increase the soil impoverishment. (Baker-FRC)

W82-01034

## SOIL MOISTURE RELATIONS IN THE SOUTHERN CALIFORNIA CHAPARRAL

San Diego State Univ., CA. Dept. of Biology. For primary bibliographic entry see Field 2D. W82-01035

WATER VAPOR CONDUCTANCE AND CO<sub>2</sub> UPTAKE FOR LEAVES OF A C<sub>4</sub> DESERT GRASS, HILARIA RIGIDA,

California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.

P. S. Nobel.  
Ecology, Vol 61, No 2, p 252-268, 1980. 5 Fig, 32 Ref.

Descriptors: \*Grasses, \*Moisture availability, Soil moisture, \*Soil-water-plant relationships, Photosynthesis, Transpiration, \*Desert plants, Arid-zone hydrology, Hydrology, Arid zone, Arid lands, Arid climates, Carbon dioxide, Soil water, *Hilaria rigida*.

Transpiration and photosynthesis were examined over a 2 year period in the field and in laboratory conditions to help reconcile the prevalence of *Hilaria rigida* with potentially adverse ambient environmental factors. Availability of soil water appeared to be the major influence on seasonal stomatal activity of *Hilaria rigida* over the study period in the Colorado desert section of the Sonoran desert. Major stomatal opening occurred for 4.6 mo in the relatively cool winter-spring and for 1.7 mo in the late summer-early fall. The temperature optimum for carbon dioxide uptake was generally above daytime temperatures, particularly in the winter. When the daytime growth temperature was raised from 16 to 49 degrees C in laboratory experiments, the temperature optimum for CO<sub>2</sub> uptake shifted from 29 to 43 degrees C. Besides the rather high temperature optimum for CO<sub>2</sub> uptake, *H. rigida* displayed other typical C<sub>4</sub> characteristics including Kranz anatomy, a low CO<sub>2</sub> compensation point, and a lack of light saturation of CO<sub>2</sub> uptake at full sunshine. Under optimal field conditions, the CO<sub>2</sub> uptake rate can be higher than that reported for other species. The accompanying high after use efficiency may help explain the success of this hardy grass in both the Mojave and Sonoran deserts. (Baker-FRC)

W82-01039

RESPONSE OF FABABEAN YIELD, PROTEIN PRODUCTION AND WATER USE TO IRRIGATION,

Department of Agriculture, Lethbridge (Alberta). Research Station.

K. K. Krogman, R. C. McKenzie, and E. H. Hobbs.  
Canadian Journal of Plant Science, Vol 60, No 1, p 91-96, January, 1980. 4 Fig, 2 Tab, 7 Ref.

Descriptors: \*Moisture availability, \*Crop yield, Moisture stress, Drought, Irrigation, Farming, \*Fababeans, Seeds, Straw, Soil moisture, \*Soil water-plant relationships, \*Alberta, Canada.

The yield and quality responses of fababeans to variable soil moisture levels were investigated and

the water requirements of this crop in southern Alberta were determined. Soil moisture was varied by time of stopping irrigation or by level of maintained moisture. Increased supplies of soil moisture increased the yields of seed, straw and crude protein. Evapotranspiration for the growing season averaged 344 mm, which is 16% greater than that of irrigated cereals. Efficiency of water use was about constant over the range of treatments, and yields were linearly correlated with evapotranspiration. Soil moisture must be maintained at least above 50% of the available range to achieve the full yield potential of fababeans. The potential yield of crude protein equals or exceeds that of other irrigated crops in southern Alberta. While limitations such as annual variations in length of growing season may prevent the attainment in all years of maximum yields as demonstrated in the tests conducted in this experiment, fababeans will produce high yields of seed and straw, representative of high production of vegetable protein, if soil moisture stress is not allowed to develop. (Baker-FRC)

W82-01089

## 2J. Erosion and Sedimentation

SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,

Department of Water Affairs, Pretoria (South Africa).

For primary bibliographic entry see Field 7B. W82-00680

DEBRIS FLOW DEPOSITS OF EARLY MIocene AGE, DEADMAN STREAM, MARLBOROUGH, NEW ZEALAND,

Canterbury Univ., Christchurch (New Zealand). Dept. of Geology.

D. W. Lewis, M. G. Laird, and R. D. Powell.  
Sedimentary Geology, Vol 27, No 2, p 83-118, August, 1980. 16 Fig, 53 Ref.

Descriptors: \*River basin development, \*Geologic history, \*Sediments, Flow, \*Debris basins, Sandstones, Conglomerate rocks, Deadman stream, \*New Zealand.

An analysis is presented on conformable succession of Early Miocene conglomerates and sandstones lying between massive marine mudstones in Deadman Stream, Marlborough, New Zealand. The coarse sediments were deposited by various subaqueous debris-flow mechanisms during an early pulse of tectonism that ultimately resulted in Plio-Pleistocene eversion of the Kaikoura Mountains. High-viscosity flows and slurry-creep flow mechanisms are reflected in sparse pebbly mudstones and rare sandy conglomerates. Low-viscosity flows are reflected by other deposits that have little mud matrix. The largest clasts in the deposits have a preferred planar orientation and a preferred long-axis orientation parallel to flow direction. Microfossil data from the mudstones indicate sedimentation in an environment of outer neritic to upper bathyal aspect. Most detritus is abraded, and deposits generally fill broad shallow channels. Channelling appeared to remain relatively fixed throughout the accumulation of hundreds of meters of superimposed, commonly amalgamated debris-flow deposits. The focus of deposition probably lay shoreward of any submarine canyon or fan. (Small-FRC)

W82-00694

HOLOCENE SEQUENCES ON AN EMBAYED HIGH-ENERGY COAST: AN EVOLUTIONARY MODEL,

Geological Survey of New South Wales, Sydney (Australia). Dept. of Mineral Resources and Development.

P. S. Roy, B. G. Thom, and L. D. Wright.  
Sedimentary Geology, Vol 26, No 1/3, p 1-19, April, 1980. 7 Fig, 1 Tab, 7 Ref.

Descriptors: \*Estuaries, \*Sedimentation, \*Erosion, Sands, Sediment transport, Tidal effects, Coasts, Model studies, Marine geology, \*Australia.

An evolutionary model is proposed to account for the three types of Holocene embayment fill which can be applied to coastal erosion studies. South-eastern Australia has an embayed high-energy coast which shows varying degrees of infilling. The three types of embayment fill are open ocean, barrier estuary, and drowned river valley. In mid-Holocene times, the rapid accumulation of marine sand resulted in the formation of coastal sand barriers and of estuaries that progressively infilled with fluvial deposits. There is evidence that erosion dominated over accretion during the Late Holocene; sandy bays were deepened and many barriers retreated. Using the model, with extreme or prolonged wave erosion, barriers may be destroyed and estuarine deposits relocated to produce mixed fluvial/marine sediments. Also, when an estuary completely infills and river sand is supplied to the coast, similar polygenetic sediments are produced. Coastal erosion may be countered or reversed in cases such as these. Thus, the same mechanisms seem to add or remove sand, although the exact mechanism and its perhaps cyclic nature are not well understood. (Small-FRC)

W82-00695

MOVEMENT OF LOOSE, SANDY DETRITUS BY SHALLOW WATER FLOWS: AN EXPERIMENTAL STUDY,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.

A. J. Moss, P. H. Walker, and J. Hukta.  
Sedimentary Geology, Vol 25, No 1/2, p 43-66, January, 1980. 10 Fig, 30 Ref.

Descriptors: \*Sediment transport, \*Overland flow, \*Sand, Sediments, Flow channels, River flow, Salivation, Suspended sediments, Suspended load, Bed load, Erosion rate, Erosion, \*Detritus.

The interactions between flowing water and natural, loose, sandy detritus which contained small amounts of clay, silt, and pebbles were studied in flumes using small discharges over a large range of slopes. All flows strong enough to move the full size range of bed material were supercritical and channel systems always replaced the initial sheet flows after general sediment movement began. Behaviorally distinct suspended, salivation, and contact loads were found in flows as little as 1 millimeter deep. While suspended load was entrained wherever suitable particles were exposed, salivation load was always entrained to full transportation capacity in the upstream few centimeters of the bed, with later entrainment downstream balanced by deposition. Channel formation and geometry and the transportation of suspended and contact loads were largely controlled by the interaction between saltatory particles and the flow. Salivation changed from the movement of particles in individual trajectories to migration as ballistic dispersions with increased flow vigor. While saltatory grains moved in individual trajectories, transport rate increased rapidly with slope. However, the rheologic layer formed when the bed-load concentration reached about 25 percent by volume, after which transport rate increased less strongly with slope, closely following a stream-power law. Small rills were found to transport little sand when the slope was less than 0.01. However, transporting power increased significantly through the slope range 0.01 to 0.04 and became enormous by a slope of 0.3. Small overland discharges acquired considerable power to transport pebbles when flow was concentrated into channels. Processes in small channels were found to closely parallel those in rivers for the most part, but repetitive sedimentary structures contrasted sharply with those of deeper, subcritical flows. (Carroll-FRC)

W82-00776

THE NATURE OF SELECTED PRAIRIE LAKE AND STREAM SEDIMENTS,

Saskatchewan Univ., Saskatoon. Dept. of Soil Science.

D. W. Oscarson, J. S. Rogers, P. M. Huang, and W. K. Liaw.  
International Revue der Gesamten Hydrobiologie, Vol 66, No 1, p 95-107, 1981. 3 Fig, 3 Tab, 45 Ref.

Descriptors: \*Sediments, \*Chemical analysis, Clays, Lakes, Streams, Hydrobiogeography, Nutrients,

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### Group 2J—Erosion and Sedimentation

Pollutants, Organic matter, Minerals, \*Saskatchewan, Canada.

The nature of sediments of selected lakes and streams of the upper Qu'Appelle River basin was examined. Sediment samples were taken from five lakes: Buffalo, Pound, Pasqua, Echo, Mission, and Katepwa, and the Qu'Appelle River, plus two of its tributaries. Principal crystalline clay minerals present in the colloidal fractions of the sediments were smectite, vermiculite, kaolinite, mica, quartz, and feldspar. The cation-exchange capacity of the sediments varied from 16.3 to 28.8 meq/100 g, and the pH ranged from slightly acidic to slightly alkaline. The hydrous oxides of Al, Fe, Mn, and Si were present in significant quantities in both the colloidal and noncolloidal fractions of the sediments. These oxides may exert the dominant chemical control on nutrient movement and pollutant movement in aquatic environments. Calcium and magnesium carbonates comprise a significant fraction of the sediments. Most of the carbon in the sediments is in the organic form. The organic carbon content varied from 1.2 to 6.0%. Since crystalline clay minerals, poorly ordered sesquioxides, and organic matter play a vital role in the retention and cycling of nutrients and pollutants, knowledge of the nature and properties of sediments is essential in efforts to preserve and improve the quality of natural water systems. (Baker-FRC)

W82-00815

**ON LAKE BOTTOM DYNAMICS—THE ENERGY-TOPOGRAPHY FACTOR,**  
National Swedish Environment Protection Board,  
Uppsala, Water Quality Lab.  
For primary bibliographic entry see Field 2H.  
W82-00837

**GRAPHED EQUILIBRIUM PARAMETERS OF CHANNELS FORMED IN SEDIMENT,**  
Alberta Univ., Edmonton. Dept. of Civil Engineering.  
A. W. Peterson, and T. Blanch.  
Canadian Journal of Civil Engineering, Vol 7, No 1, p 93-104, 1980. 7 Fig, 1 Tab, 55 Ref.

Descriptors: \*Rivers, \*Channels, Bed load, Flumes, Irrigation canals, Canals, Computers, Gravel, Sand, Sedimentation, \*Erosion, Reviews, Graphical methods, \*Channeling, Channel forming, Sediment transport, Alluvial rivers.

The origin and potential of the four-dimensional charts produced from numerical data obtained from the equilibrium dimensions of sand rivers, gravel rivers, and laboratory flumes is presented. Problems in this field have included gross disagreements among sediment load predictions from various formulas, improper transfer of flow information to rivers and canals, and differences between sand and gravel rivers. These are caused by flumes working in a transition between phases, lack of communication between workers in the field, and inapplicability of pure deductive methods to fluid-solid mixtures. Examples of the subjects discussed are Indian sand-bed canal observations, information on gravel rivers, Cooper's (1970) world flume data analysis, and the Peterson Q-factor (volumetric water discharge) and S (slope). References chosen from the multitude written on this subject feature usable photos, graphs, and tables; freedom from specialized mathematics and speculation; and references to further useful information sources. (Cassar-FRC)

W82-00881

**SUBSURFACE DRAINAGE AND SEDIMENT TRANSPORT MODEL,**  
Florida Univ., Gainesville. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 2G.  
W82-00894

**EFFECT OF SLOPE LENGTH ON EROSION FROM LOW SLOPES,**  
Science and Education Administration, Oxford, MS. Sedimentation Lab.  
C. K. Mutchler, and J. D. Greer.

Transactions of the ASAE, Vol 23, No 4, p 866-869, 876, July/August, 1980. 2 Fig, 3 Tab, 6 Ref.

Descriptors: \*Erosion rates, \*Soil erosion, \*Slope degradation, Mathematical studies, Slopes, Erosion, Runoff, Mathematical equations.

There is general acceptance of the premise that erosion increases with increasing slope length and that soil loss is proportional to slope length to some power,  $m$ . Investigations conducted over several years have resulted in the use of 0.3 as the slope length exponent for sloping farmland, with lower values being recommended for slopes of less than 4 percent. Since most of the intensively farmed flood plain soils in the United States are located on land comprised of nearly flat slopes, field studies were undertaken to determine the slope length exponents for these slopes. Simulated rainfall was applied to eight erosion plots ranging from 23 to 813 meters long on a slope of 0.2 percent. The study results support the slope length exponents recommended in Agriculture Handbook 537, although those exponents may be conservative for slopes of 1 percent. It is recommended that consideration be given to lowering the exponent to 0.15 for slopes less than 0.3 percent and to 0.2 for slopes between 0.5 and 1.0 percent. Ponding of water on part of the slope will cause the soil loss from the nearly flat slopes to be less than that predicted by the Universal Soil Loss Equation. (Carroll-FRC)

W82-00896

**AERIAL PHOTOGRAPHY AS AN AID TO CROPLAND EROSION ANALYSIS,**  
Texas Christian Univ., Fort Worth. Dept. of Geology.

K. M. Morgan, D. R. Morris, G. B. Lee, R. W. Kiefer, and G. D. Bubenzier.

Transactions of the ASAE, Vol 23, No 4, p 907-909, 913, July/August, 1980. 2 Fig, 4 Tab, 10 Ref.

Descriptors: \*Cropland, \*Soil erosion, \*Aerial photography, Photography, Remote sensing, Erosion rates, \*Erosion control, Land management, Land use, Soil conservation, Data collections.

The development and implementation of effective soil conservation programs requires areawide erosion analysis. The Universal Soil Loss Equation is generally used to compute long-term soil losses from agricultural fields due to rill and interrill erosion for use in conservation planning. However, use of this equation is dependent on the collections of various data through field surveys. Remote sensing can provide total coverage of land use activities in watersheds and can supply accurate erosion information to agencies developing management plans for soil conservation. Color and color infrared photography at the scale of 1:60,000 were used to extract information about cropland management and conservation practices in Dane County, Wisconsin. Cropland management information determined by aerial photography included crop type, plowing, surface residue, and rotation. Information on erosion control practices covered contouring, strip cropping, and waterways. A detailed field survey of this agricultural watershed was also conducted by the Dane County Regional Plan Commission. The soil loss predictions developed on the basis of the results of the interpretations of the remote sensing air photographs were found to be in close agreement with the predictions made on the basis of the field survey results and computations made using the Universal Soil Loss Equation. (Carroll-FRC)

W82-00902

**SEDIMENT SIZES ERODED FROM CROP ROW SIDESLOPES,**  
Science and Education Administration, Oxford, MS. Sedimentation Lab.

L. D. Meyer, W. C. Harmon, and L. L. McDowell.

Transactions of the ASAE, Vol 23, No 4, p 891-898, July/August, 1980. 5 Fig, 4 Tab, 16 Ref.

Descriptors: \*Soil erosion, \*Particle size, \*Sediments, Soil properties, Physical properties, Erosion, \*Cropland, Storm runoff, \*Furrows.

The soil eroded from row sideslopes of land in no-till production and other interrill areas constitutes a significant proportion of the sediment from cultivated cropland during erosive rainstorms. The size distribution of these sediments is a major determinant of their transportability by runoff and their potential for subsequent deposition. Crop row sideslopes of ten soils, mostly silt loams, were tested under simulated rainstorms to determine the size distribution of the undispersed eroded sediment. These size distributions were compared with those of dispersed eroded sediment and of the original soil surface. The sizes of sediment eroded from crop row sideslopes varied considerably from soil to soil, both in magnitude and in distribution pattern. Aggregates comprised much of the sediment from cohesive soils. Sediments from fine soils were often coarser than those from soils with larger primary particle sizes due to the greater aggregation of the fine soils. Sediment sizes were not significantly affected by major changes in rainfall intensity, continued erosion, or the presence or absence of crop canopy. The undispersed eroded sediment was coarser than either the surface soil or the dispersed sediment for all soils, and much coarser for many soils. The size distribution of interrill sediment appears to be a fairly distinct characteristic of a given soil in a given condition. (Carroll-FRC)

W82-00903

**INTERPRETATION OF SURFACE-WATER CIRCULATION, ARANSAS PASS, TEXAS, USING LANDSAT IMAGERY,**  
Texas Univ. at Austin.

For primary bibliographic entry see Field 7B.  
W82-00904

**SEDIMENT YIELD FROM A FLATLAND WATERSHED,**  
Science and Education Administration, Oxford, MS. Sedimentation Lab.

C. E. Murphree, and C. K. Mutchler.

Transactions of the ASAE, Vol 24, No 4, p 966-969, July/August, 1981. 3 Fig, 3 Tab, 6 Ref.

Descriptors: \*Sedimentation, \*Deltas, \*Mississippi River, Rivers, Sediments, Sediment load, Sediment erosion, Erosion, Watersheds, Watershed management, Watershed protection, \*Mississippi Delta.

Erosion and sediment yields from two adjacent watersheds in the Mississippi Delta over a 5 year period are reported. The watersheds are located on the G. L. McWilliams Farm near Clarksdale, Mississippi. One watershed had a silt loam soil and the other a silty clay soil. Practically all precipitation was in the form of rainfall. Both watersheds had been used for continuous cotton production for many years, including the 5 yr study period. The five annual amounts of rainfall were well distributed around their 5 yr average, which was within 2% of the long-term average amount. The 5-yr average monthly values differed greatly. Simple linear relationships were developed by grouping the sediment yield, runoff, and rainfall data by seasons. An equation for runoff was derived as a function of precipitation for data collected from November to June and another equation for data collected from July to October. Storm runoff was related to precipitation, and sediment yield was related to storm runoff during two seasons of the year. These equations were then combined to relate sediment yield to monthly rainfall for four separate crop and climatic periods. The equations derived should be suitable for predicting sediment yield and runoff from much of the 140,000 ha of graded flatland in the delta region. Care should be taken in using them outside of this climatic area. Erodibility of soils must be considered when predicting sediment yield. As these results represent sediment yield from watersheds with an essentially unrestricted outlet, they thus represent maximum values to be expected. (Baker-FRC)

W82-00941

**MECHANICS OF MUDFLOW MOBILIZATION IN LOW-ANGLED CLAY SLOPES,**  
Michigan State Univ., East Lansing. Dept. of Civil and Sanitary Engineering.

L. E. Vallejo.

## WATER CYCLE—Field 2

### Chemical Processes—Group 2K

Engineering Geology, Vol 16, No 1/2, p 63-70, July, 1980. 2 Fig, 2 Tab, 17 Ref.

Descriptors: \*Mudflows, \*Clays, \*Soil mechanics, Estimating equations, Erosion, Rocks, Slopes.

An analytical explanation of mudflow mobilization on flat surfaces is presented. Mudflows consisting of a mixture of hard clay fragments or rocks with mud can be considered a mass of concentrated grains that are dispersed in a flowing medium. The movement of the grain flow and the unit weight of the fluid medium can be quantified. The least slope angles of mudflow were calculated using the Bagnold theoretical method for field cases, and the calculated results compared well with field measurements. The Bagnold method is an alternative to the undrained loading and the excess pore water or artesian pressure effects which have been used to explain mudflow mobilization on some low angled slopes. The Bagnold method is successful because it is based on the assumption that a mixture of solids and fluid will flow instead of slide. It is an excellent tool to interpret mobilization of mudflows made up of hard clay fragments or pieces of rock in a soft clayey matrix such as mud. (Small-FRC)

W82-00989

#### CHEMICAL MASS-WASTING OF THE NORTHERN YUCATAN PENINSULA BY GROUNDWATER DISSOLUTION,

Geological Survey, Reston, VA.

For primary bibliographic entry see Field 2K.

W82-01015

## 2K. Chemical Processes

#### MODELING OF PROCESSES OF DECOMPOSITION OF ORGANIC MATTER IN BOTTOM SEDIMENTS,

Akademiya Nauk Ukrainskoj SSR, Kiev. Inst. Hidrobiologii.

For primary bibliographic entry see Field 5B.

W82-00553

#### CORRELATION OF MICROBIAL DEGRADATION RATES WITH CHEMICAL STRUCTURE,

Environmental Research Lab., Athens, GA.

N. L. Wolfe, D. F. Paris, W. C. Steen, and G. L. Baughman.

Environmental Science and Technology, Vol 14, No 9, p 1143-1144, 1980. 2 Fig, 22 Ref.

Descriptors: \*Natural waters, \*Microbial degradation, Biodegradation, \*Organic compounds, Phenols, Kinetics, Hydrolysis, Sediments, Chemical reactions.

Relationships are established between structure and reactivity for the microbial degradation of selected organic compounds. Second-order microbial degradation rate constants were determined in natural water samples for six compounds and were found to correlate with the second-order alkaline hydrolysis rate constants. Also, second-order microbial degradation rate constants for four phthalate esters were obtained with organisms from sediment-water samples. These were shown to correlate with the second-order alkaline hydrolysis rate constants. Similar correlations are demonstrated for the rates of oxidation of substituted phenols by mixed microbial cultures isolated from soils and Hammett constants. It is important to note that the correlations demonstrated here offer some insight into a method of predicting microbial degradation rate constants in natural waters and perhaps soils as well. (Baker-FRC)

W82-00656

#### INFLUENCE OF GASEOUS NITRIC ACID ON SULFATE PRODUCTION AND ACIDITY IN RAIN,

Environmental Sciences Research Lab., Research Triangle Park, NC.

For primary bibliographic entry see Field 5B.

W82-00642

#### ACID PRECIPITATION: THE IMPORTANCE OF NITRIC ACID,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

J. N. Galloway, and G. E. Likens.

Atmospheric Environment, Vol 15, No 6, p 1081-1085, 1981. 7 Fig, 26 Ref.

Descriptors: \*Acid rain, \*Nitric acid, \*Sulfuric acid, Fossil fuels, Air pollution effects, Environmental effects, Precipitation.

Using the information on temporal trends of sulfate and nitrate ions accumulated from the long-term precipitation data collected at Hubbard Brook Experimental Forest, New Hampshire, temporal trends were determined in the maximum contributions of sulfuric acid and nitric acid to the acidity of the precipitation. Nitric acid in acid rain was introduced primarily by increased emissions of NOX from fossil fuel combustion. Its contribution to the acidity of precipitation is becoming increasingly significant. The maximum contribution of H<sub>2</sub>SO<sub>4</sub> to the acidity of precipitation is 73% in summer and 59% in winter. For HNO<sub>3</sub>, it is 31% in summer and 61% in winter. This analysis indicated that the importance of H<sub>2</sub>SO<sub>4</sub> has decreased by about 30% relative to HNO<sub>3</sub> and HNO<sub>3</sub> has increased by about 50% relative to H<sub>2</sub>SO<sub>4</sub> for the years studied. These conclusions should be applicable to most of the eastern United States. (Small-FRC)

W82-00643

#### ACIDITY FLUCTUATIONS AT A BROADLAND SITE IN NORFOLK,

Ministry of Agriculture, Fisheries and Food, Norwich (England). Crops Research Lab.

L. M. Gosling, and S. J. Baker.

Journal of Applied Ecology, Vol 17, No 2, p 479-490, August, 1980. 5 Fig, 3 Tab, 20 Ref.

Descriptors: \*Acidity, \*Environmental effects, \*Acidic soils, Water pollution, Chemical properties, Aquatic plants, Aquatic animals, Agriculture, Pyrite, Wetlands, Acidic water, Water, Sulfates, Oxidation, Sulfides, \*Sulfuric acid, Tropical regions, \*Soil chemistry.

Acid sulfate soils, which are soils containing a relatively high level of sulfides which on oxidation form sulfuric acid, pose serious problems for agriculture in tropical regions. The main difficulty experienced from such soils in Great Britain has been the clogging of field drains with ochre deposits. However, Calthorpe Broad, a wetland site in Norfolk, experienced an abrupt change in acidity from near-neutrality to just above pH 3.0 in 1970. As a result, the entire fish population of the area died, as did freshwater mussels and most aquatic macrophytes. The first rise in acidity brought a dramatic invasion by the acidophilous alga Tribonema minus. The pH of free water returned to neutrality after a period of acute acidity, but similar fluctuations occurred in most years between 1971 and 1979. Dams maintain the perched water table in the area around the broad during the winter, but evaporation and seepage cause extreme drops in water levels during the summer. As a result, the agricultural soil, which was rich in pyrites, was subjected to alternate drying and saturation, causing oxidation of the pyrite and formation of sulfuric acid. Treatment by the addition of lime in 1978 maintained neutral water in the broad, even though the acidity of the water in adjacent ditches continued to fluctuate. While all plant groups present before 1970 reappeared, only one fish species has returned to the area. (Carroll-FRC)

W82-00656

#### TRACE CONSTITUENTS IN CLOUD WATER, RAINWATER AND AEROSOL SAMPLES COLLECTED NEAR THE WEST COAST OF INDIA DURING THE SOUTHWEST MONSOON,

Bhabha Atomic Research Centre, Bombay (India).

Air Monitoring Section.

For primary bibliographic entry see Field 2B.

W82-00676

#### CHEMISTRY OF LAKE WATER AND GROUNDWATER IN AREAS OF CONTRAST-

#### ING GLACIAL DRIFTS IN EASTERN MINNESOTA,

Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.

R. B. Brugam.

Hydrobiologia, Vol 80, No 1, p 47-62, April, 1981. 4 Fig, 7 Tab, 18 Ref.

Descriptors: \*Lakes, \*Chemical composition, Water analysis, Salts, Deicers, Calcium, Magnesium, Sulfates, Carbonates, Silicon dioxide, Groundwater, Ions, Roads, Water pollution sources, \*Groundwater, Glacial drift, Glacial aquifers, Glacial lakes, \*Minnesota.

During the winter of 1977-78 water samples were collected from 28 lakes in east-central Minnesota, 15 from Superior-lobe drift and 13 from Grantsburg-lobe drift. Groundwater samples were collected from wells near each lake. The major sources of ionic input into the study lakes are assumed to be groundwater and direct runoff from the watershed. Mann-Whitney U tests were used to determine if any statistical significance could be attached to differences between major-ion concentrations of lakes on tills of the Superior versus Grantsburg lobe. Concentrations of Ca(2+), Mg(2+), HCO<sub>3</sub>(-) SO<sub>4</sub>(-) were significantly higher in samples of groundwater from the Grantsburg lobe. No correlation was noted between groundwater concentrations of particular ions and lake-water concentrations of the same ions, implying that the sources of dissolved ions in lake water are shallow groundwater and soil leachates rather than the deeper groundwater sampled here. Na(+) and Cl(-) concentrations in some lakes appear to be strongly influenced by the use of de-icing salt on highways in winter rather than by differences in drift lithology. (Baker-FRC)

W82-00821

#### EFFECTS OF ION-PAIRING ON CALCULATIONS OF IONIC ACTIVITIES OF MAJOR IONS IN FRESHWATER,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.

C. E. Boyd.

Hydrobiologia, Vol 80, No 1, p 91-93, April, 1981. 2 Tab, 7 Ref.

Descriptors: \*Natural waters, \*Ionic interference, \*Ions, Mineralization, Chemical reactions, Chemical composition, Chemical potential, Metals, Inorganic chemicals, Ion-pairing.

The objective of this study was to determine whether ion pairing had an appreciable effect on the calculation of ionic concentration, ionic strength, and ionic activities of major ions in natural waters. Measured ionic concentrations for 10 waters which represented a wide range in water chemistry were obtained from Livingstone. Ionic activities were first calculated by using the Debye-Hückel equation to calculate activity coefficients for all ions and multiplying the activity coefficients by the measured molar concentrations of the ions to give activities. Next, the iterative procedure of Adams was used to calculate ionic activities that were corrected for ion-pairing. Ion-pairing had no significant effect on ionic activities of Cl(-), Na(+), or K(+). The effect of ion-pairing on ionic activities of bicarbonate was slight. The influence of ion-pairing on ionic strength and ionic activities of Ca(2+), Mg(2+), and SO<sub>4</sub>(2-) increased with increasing ionic strength. The effect of ion pairing on the calculation of ionic strength was also substantial in the highly mineralized samples. These findings suggest that it is important in rigorous work to correct for ion-pairing in calculating ionic activities for all water samples except those that are not appreciably mineralized. A large percentage of the total iron, manganese, zinc, and copper in water exists as ion-pairs rather than as free ions. (Baker-FRC)

W82-00823

#### RELATIONSHIPS BETWEEN WATER CHEMISTRY AND RESPIRATION RATE IN SEVERAL POPULATIONS OF LYMPNÆA PREGERA MULLER (GASTROPODA:MOLLUSCA),

G. Dussart, and R. Kay.

## Field 2—WATER CYCLE

### Group 2K—Chemical Processes

Hydrobiologia, Vol 69, No 1/2, p 57-65, March, 1980. 4 Tab, 34 Ref.

Descriptors: \*Chemical properties, \*Mollusks, \*Respiration, Oxygen, Hardness, Calcium, Potassium, Cations, Anions, Correlation analysis, Water quality.

In this investigation of the effects of water chemistry on L. peregra, the most important components producing such effects were determined. Specimens were obtained in North West England; respiration rates were studied in the laboratory, and the effects of water chemistry on weight-specific oxygen consumption were noted. Some relationship was found between water chemistry and wet-dry weight ratios, between oxygen consumption and live-wet weight, and between oxygen consumption and shell-free dry weight. There were interpolation differences in respiration rates between snails from different sites within the same water hardness classification. Calcium and potassium concentrations appeared to significantly affect respiration rates when tested in waters of varying cations but constant anion concentrations. Cations included calcium, sodium, magnesium, and potassium. The anion used was bicarbonate. No significant differences were found in respiration rates of populations of snails taken from the same site but in different years. (Small-FRC) W82-00854

BIOGEOCHEMISTRY OF THOREAU'S BOG, CONCORD, MASSACHUSETTS, Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering. H. F. Hemond. Ecological Monographs, Vol 50, No 4, p 507-526, December, 1980. 14 Fig, 6 Tab, 42 Ref.

Descriptors: \*Bogs, \*Hydrogen ion concentration, \*Acidity, Swamps, Chemical properties, Acid rain, Peat soils, Ions, Geologic history, \*Biochemistry, \*Thoreau's Bog, Massachusetts.

The pH control mechanism of the bog system of Thoreau's Bog or Gowings Swamp is presented in terms of the interaction of mineral acidity and weak acids. This bog is a floating-mat Sphagnum bog developed in a glacial kettle hole. The bog is ombrotrophic, with an annual water input of 1.45 m and an annual runoff of 0.24 m. Metal inputs are: 88 mg/sq m/yr for K, 132 mg/sq m/yr for Mg, and 54 mg/sq m/yr for Pb. The distribution of K and Mg is vertical in accordance with the inhomogeneous ion exchange chemistry of peat, while lead is distributed in accordance with historical trends in atmospheric lead fallout. Net peat accumulation rate was 180 g/sq m/yr, and annual storage rates were 36 mg/sq m/yr for K, 54 mg/sq m/yr for Mg, and 46 mg/sq m/yr for Pb. Organic acids at concentrations of 10 to the minus 3rd power eg/liter maintain bog acidity at pH 3.8. The contribution of acid rain is offset by alkalinity increases of the same magnitude resulting from sulfate reduction and nitrate uptake. (Small-FRC) W82-00887

ANALYSIS OF PRECIPITATION CHEMISTRY AT A CENTRAL PENNSYLVANIA SITE, Pennsylvania State Univ., University Park. Dept. of Meteorology. V. C. Bowersox, and R. G. De Pena. Journal of Geophysical Research, Vol 85, No C10, p 5614-5620, October, 1980. 10 Fig, 2 Tab, 11 Ref.

Descriptors: \*Chemistry of precipitation, \*Sulfates, \*Acid rain, Acidity, Nitrates, Ammonia, Hydronium ion, Snow, Storms, Seasonal variation, Pennsylvania, Rain, Precipitation.

Data collected at the multistate atmospheric power production pollution study (MAPPPS) precipitation chemistry network were analyzed in detail. Precipitation was sampled on a storm-by-storm basis at a rural central Pennsylvania site during the period January 1, 1977, to December 31, 1978. Samples were analyzed for sulfate, nitrate, ammonium, and hydronium ion concentrations. Sulfate concentration varied seasonally, with high values in summer and low values in winter. Sulfate is of

interest as the major determinant of precipitation acidity, particularly in rain. The principal contributor to H<sub>3</sub>O was sulfuric acid, but the acidity of snow was determined principally by NO<sub>3</sub>. The NH<sub>4</sub> in precipitation can be explained by assuming equilibrium between cloud water and gaseous ammonia in air. There was a good stoichiometric balance of the four major inorganic ions. Knowledge of the nature of acid-determining components in rain can be used to help establish strategies to control the quality of precipitation. (Small-FRC) W82-00980

MASS-TRANSPORT LIMITATION TO THE RATE OF REACTION OF GASES IN LIQUID DROPLETS: APPLICATION TO OXIDATION OF SO<sub>2</sub> IN AQUEOUS SOLUTIONS, Brookhaven National Lab., Upton, NY. S. E. Schwartz, and J. E. Freiberg. Atmospheric Environment, Vol 15, No 7, p 1129-1144, 1981. 14 Fig, 2 Tab, 29 Ref.

Descriptors: \*Oxidation, \*Sulfur compounds, Sulfur dioxide, Water pollution sources, Clouds, Fog, Chemical reactions, Mass transfer.

The role of mass transport in the oxidation of sulfur dioxide to sulfate in aqueous droplets is considered. As in any gas-liquid reaction, competition between mass transport and reaction is involved. Characteristic times associated with the several steps in the overall process have been identified, and expressions presented whereby these characteristic times may be evaluated for reactions in spherical drops. By comparing these characteristic times it may be determined whether a measured rate of reaction is equal to the intrinsic reaction rate or is limited by mass transport in the gas phase, at the air-water interface, or in the aqueous phase. Criteria are suggested that must be fulfilled for spatial and temporal uniformity to be achieved under experimental conditions or in the ambient atmosphere. Three steady-state criteria must be satisfied in order for a steady state to be achieved. After a steady state is reached, the concentration profiles may or may not be established at the surface, depending on the relative magnitudes of the several characteristic times. A theoretical model is presented wherein the extent of decrease in reaction rate may be calculated for each of the three mass-transport limiting processes, for a reaction that is first order in the concentration of the dissolved reagent species, and for mass transport in each of the two phases occurring by molecular diffusion. This theoretical framework has been applied to an examination of laboratory studies of sulfur dioxide oxidation in suspended droplets and to consideration of mass transport limitation to the rate of oxidation of sulfur dioxide in clouds and fogs. (Baker-FRC) W82-00994

CHEMICAL MASS-WASTING OF THE NORTHERN YUCATAN PENINSULA BY GROUNDWATER DISSOLUTION, Geological Survey, Reston, VA.

B. B. Hanshaw, and W. Back. Geology, Vol 8, No 5, p 222-224, May, 1980. 2 Fig, 9 Ref.

Descriptors: \*Erosion rates, Saline-freshwater interfaces, \*Dissolution, Calcite, \*Yucatan Peninsula, \*Chemical degradation, Groundwater recharge, \*Carbonate rocks, Limestone, Recharge, Solubility.

The northern part of the Yucatan Peninsula is the site of chemical erosion in its Tertiary carbonate rocks, predominantly limestone. For the 65,500 sq km study area, the mean annual discharge (equivalent to recharge) is 9800 million cu meters or 8.6 million cu meters for each 1 km of the 1100 km coastline. The area is flat and lowlying, with no stream channels. Rainfall averages 1000 mm per year. Soil cover is thin, infiltration is rapid, and transmissivity of the limestone is very high. Inland, the recharging fresh water becomes saturated with calcite, dissolving about 37.5 metric tons of calcite per sq km per year as it flows toward the coast. At the coast, the saline water also becomes saturated with calcite. When these two saturated waters of

different salinities mix in the dispersion (or active mixing) zone the resulting solution is capable of dissolving as much as 1.2 nmol per liter additional calcite (or an additional 8.6 million mol per km coastline per year). The discharge near Xel Ha is about nine times greater than the average for the coastline. Calculations indicate that the lagoon in this area could be chemically incised within 3000 years. The zone of dispersion, about 3 m thick and extending 1 km inland, could completely dissolve in about 8700 years. (Cassar-FRC) W82-01015

PHOSPHORUS, NITROGEN, AND ORGANIC CARBON FLUX IN A HEADWATER STREAM, Georgia Univ., Athens. Dept. of Zoology. J. L. Meyer, G. E. Likens, and J. Sloane. Archiv für Hydrobiologie, Vol 91, No 1, p 28-44, March, 1981. 5 Tab, 46 Ref.

Descriptors: \*Streams, \*Nutrients, \*Chemical properties, Phosphorus, Nitrogen, Carbon, \*Ecosystems, Seasonal variation, Organic carbon, Nitrogen compounds, Particulate matter, Dissolved solids, Gases, \*Solute transport, Chemical reactions, Environmental effects.

Physical, chemical, and biological processes which transform nutrients entering a stream ecosystem affect the rate of transport of the element as well as its availability to the biological community. The processes responsible for these conversions in a particular stream will vary in form, rate, and relative importance for different elements. The processing of phosphorus, nitrogen, and organic carbon in Bear Brook, a forest stream in New Hampshire, were examined by constructing mass balances for each element over a one-year period. Annual inputs of nitrogen exceeded exports by 8 percent, while exports of phosphorus exceeded inputs by 12 percent. An earlier study assumed that the organic carbon budget was balanced. The stream exported 69 percent of the coarse particulate organic carbon inputs, 78 percent of coarse particulate organic nitrogen inputs, and 73 percent of coarse particulate organic phosphorus inputs in the form of fine particulates (between 0.45 micrometers and 1 millimeter), dissolved solids (less than 0.45 micrometers), or gases. Organic carbon was exported primarily in the gaseous or dissolved fraction, phosphorus was exported mostly as fine particulates, and nitrogen was transformed primarily to dissolved matter. Fluvial inputs had lower carbon to nitrogen and carbon to phosphorus ratios and a higher nitrogen to phosphorus ratio than did fluvial exports. There was a lower nitrogen to phosphorus atomic ratio in fluvial exports during the growing season than during the rest of the year. The discharge relationships observed for these elements suggest that annual changes in streamflow have different effects on the export/input ratio for each element, with organic carbon budgets showing the least variation, followed by nitrogen. The phosphorus budget appears to be the most sensitive to changes in the annual discharge. (Carroll-FRC) W82-01021

NUTRIENT BUDGET STUDIES FOR FORESTS ALONG AN ELEVATIONAL GRADIENT IN NEW MEXICO, New Mexico Univ., Albuquerque. Dept. of Biology. J. R. Gosz. Ecology, Vol 61, No 3, p 515-521, 1980. 1 Fig, 2 Tab, 24 Ref.

Descriptors: \*Nutrients, \*Ecosystems, Forests, Cycling nutrients, \*Watersheds, Soils, Hydrology, Calcium, Magnesium, Potassium, Sodium, \*New Mexico, Nutrient budget.

This paper reports studies of element inputs in bulk precipitation and outputs in stream water for a number of watersheds in New Mexico. These watersheds are located in the Tesuque Watershed Study area in the Sangre de Cristo Mountains. A number of vegetational zones occur in this area due to the influence of elevation on temperature and moisture gradients. The net organic matter increment of one of the watersheds has been estimated to be negative. The patterns in the output

## Estuaries—Group 2L

and net change of calcium, magnesium, potassium and sodium among watersheds are related to soil chemistry and stream discharge rates. These factors may not be related to soil chemistry and stream discharge rates. These factors may not be related to the net organic matter increment of the ecosystem. Actual atmospheric inputs of these elements to some of the ecosystems may be an order of magnitude greater than those measured in bulk precipitation. Nitrogen outputs in stream water are strongly regulated by all of the watershed ecosystems, including the one which appears to have a negative net organic increment. Low losses of nitrogen in stream water, however, do not mean that a system will minimize other types of N losses such as denitrification. Nutrient budgets generated from bulk precipitation and stream water discharge in the Southwest cannot prove or disprove hypotheses about nutrient regulation by net organic matter increment. Additional inputs and outputs must be quantified before a valid test can be made of the hypothesis. (Baker-FRC)  
W82-01036

## 2L. Estuaries

**MEASUREMENT OF PH IN THE ESTUARINE ENVIRONMENT ON THE NBS SCALE. (LA MESURE DU PH EN MILIEU ESTUARIEN SUR L'ECHELLE NBS),**  
McGill Univ., Montreal (Quebec). Dept. of Chemistry.  
For primary bibliographic entry see Field 7B.  
W82-00521

**PARTITIONING OF NO. 2 FUEL OIL IN CONTROLLED ESTUARINE ECOSYSTEMS. SEDIMENTS AND SUSPENDED PARTICULATE MATTER,**  
Rhode Island Univ., Kingston. Graduate School of Oceanography.  
P. J. Gearing, J. N. Gearing, R. J. Pruell, T. L. Wade, and J. G. Quinn.  
Environmental Science and Technology, Vol 14, No 9, p 1129-1136, September, 1980. 6 Fig, 2 Tab, 52 Ref.

Descriptors: \*Estuarine environment, \*Oil pollution, \*Sediments, Suspended sediments, Suspended solids, Ecosystems, Ecology, Hydrocarbons, Fate of pollutants.

The interaction of oil hydrocarbons with estuarine suspended particulate matter and sediments is considered. No. 2 fuel oil was added as a dispersion in semiweekly doses to three controlled estuarine ecosystems. Samples of suspended particulate matter and sediments were analyzed by gas chromatography for saturated and aromatic hydrocarbons. Fractionation of the oil in the water column by adsorption to particulate matter resulted in the sedimentation of about 50% of the insoluble, saturated hydrocarbons, but less than 20% of the more soluble, aromatic hydrocarbons. The oil-derived hydrocarbons were slowly mixed down through the bioturbation zone. Biodegradation and other processes effected the removal of most of the hydrocarbons soon after the additions ended, but a residue of 10-20% in the form of branched alkanes, cycloalkanes, and aromatics in an unresolved complex mixture persisted more than 1 year later. (Baker-FRC)  
W82-00541

**CIRCULATION AND ENERGETICS OF A DEEP, STRONGLY STRATIFIED INLET,**  
Institute of Ocean Sciences, Sidney (British Columbia).  
H. J. Freeland, and D. M. Farmer.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1398-1410, September, 1980. 8 Fig, 3 Tab, 18 Ref.

Descriptors: \*Model studies, \*Fjords, \*Flow characteristics, \*Flow friction, \*Tidal effects, Mathematical models, Inlets, Flow characteristics, Stratification, Mixing, Tidal hydraulics, Froude number, \*Saline-freshwater interfaces, \*Knight Inlet, British Columbia.

A theoretic model describing steady flow in a strongly stratified fjord inlet was compared to the observed flow behavior of Knight Inlet, British Columbia. Some aspects of the model gave closer agreement with reality than others. The model was useful in assessing the limit of small interfacial friction coefficients. Interfacial friction was previously thought to dominate the flow. Inlets of this type possess circulations which usually adjust to maintain the interfacial Froude number at unity near the mouth. However, evidence is presented to show that Knight Inlet does not conform to this pattern. The mean circulation in this inlet was found to be driven by tidal interactions with little contribution from the wind. (Geiger-FRC)  
W82-00547

**RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS, BACTERIAL INDICATORS, AND THE OCCURRENCE OF ENTERIC VIRUSES IN ESTUARINE SEDIMENTS,**  
Bayor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.  
For primary bibliographic entry see Field 5A.  
W82-00574

**FACTOR ANALYSIS OF THE IMPACT OF THE ENVIRONMENT ON MICROBIAL COMMUNITIES IN THE TVARMINNE AREA, SOUTHERN COAST OF FINLAND,**  
Zoological Station, Tvarminne (Finland).  
For primary bibliographic entry see Field 5C.  
W82-00672

**EFFECTS OF ENVIRONMENTAL FACTORS ON MICROBIAL POPULATIONS IN BRACKISH WATERS OFF THE SOUTHERN COAST OF FINLAND,**  
Zoological Station, Tvarminne (Finland).  
P. Vaastanen.  
Applied and Environmental Microbiology, Vol 40, No 1, p 48-54, July, 1980. 4 Tab, 29 Ref.

Descriptors: \*Microbial studies, \*Environmental effects, Populations, Temperature effects, Wind, Seasonal variations, \*Finland, Coasts, \*Estuarine environments, Brackish water, Seawater, Microorganisms, Humic acids, Chlorophyll, Organic matter, Rainfall, Wastewater outfalls, Effluents, Wastewater.

The effects of environmental factors on seasonal changes in microbial populations were studied in the Tvarminne area, off the southern coast of Finland. Samples were collected at surface levels over 1 to 2 week intervals in 1976-78. Fourteen microbiological and 10 environmental parameters were determined. Stepwise multiple regression analysis was used to explain seasonal variation in the microbiological parameters. Separate analyses were made of the data from the open-water and ice-covered periods. In analyses of data from both periods, the environmental factors included accounted for a significant proportion of the variation in the parameters for community respiration (90%) and bacterial spores (80%), and a smaller proportion (60-65%) of the variation in total counts of bacteria and plate counts of psychrophiles and yeasts. Lower values (40-55%) were obtained for the variation in the other microbiological parameters. The environmental factors with maximal contributions were organic matter, water temperature, chlorophyll, and salinity, but rainfall and winds also explained part of the variation in some microbiological parameters. In winter studies the results differed from all other seasons, the variation being controlled by parameters indicative of freshwater outflows, including humic matter, salinity, water temperature, and rainfall. (Baker-FRC)  
W82-00683

**SPATIAL DISTRIBUTIONS OF POLLEN IN SURFACE SEDIMENTS OF THE POTOMAC ESTUARY,**

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.  
G. S. Brush, and R. S. DeFries.  
Limnology and Oceanography, Vol 26, No 2, p 295-309, March, 1981. 5 Fig, 6 Tab, 23 Ref.

Descriptors: \*Pollen, Sediment transport, Land use, \*Estuaries, \*Sediments, Tracers, \*Potomac River, Trees, Deposition, Tidal effects, \*Spatial distribution.

Tree pollen in surface sediments of the Potomac Estuary was proportionally representative of trees growing in the area for many of the species (oak, pine, birch, hickory, elm, ash, and hazelnut-ironwood). No pollen from the tulip poplar, a major tree, was found in sediments, probably because its flowers do not release pollen to the air. Sweet gum, red maple, beech, holly, and black gum were underrepresented by the pollen, and a few minor species were overrepresented. Pollens from trees restricted to the upper watershed 60 km upstream of the tidal limit were not present in downstream estuarine deposits. Comparisons of the variability in the pollen data and in the corresponding tree data from the adjacent watershed led to conclusions that pollen grains are differentially dispersed before being deposited and are not transported great distances. These studies imply a possible use of pollen as tracer particles to determine the effects of land use on one part of a watershed on various parts of the estuary. (Cassar-FRC)  
W82-00737

**QUANTITATIVE ASSESSMENT OF TIDAL WETLANDS USING REMOTE SENSING,**  
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.  
For primary bibliographic entry see Field 7B.  
W82-00781

**GENERAL MORPHOLOGY AND SEDIMENT PATTERNS IN TIDAL INLETS,**  
South Carolina Univ., Columbia. Dept. of Geology.  
M. O. Hayes.  
Sedimentary Geology, Vol 26, No 1/3, p 139-156, April, 1980. 16 Fig, 1 Tab, 29 Ref.

Descriptors: \*Inlets, \*Sedimentology, \*Tidal effects, Estuaries, Sediment transport, Morphology, Deltas, Channel morphology, Tides, Sandbars.

Inlet-affiliated sedimentary barrier island units usually include an ebb-tide delta, a flood-tide delta, and inlet-fill sequences created by inlet migration and recurring spit growth. Ebb-tide deltas include a main ebb channel flanked by linear bars on either side and a terminal lobe at the seaward end. The channel is bordered by a platform of sand with swash bars. Here the sand is coarse and contains polymodal cross-bedding with a slight ebb dominance. Flood-tidal deltas include a flood ramp and bifurcating flood channels on the seaward side and ebb shields, ebb splits, and spillover lobes on the landward side. A stratigraphic sequence of a typical flood tidal delta would be bidirectional, large-scale crossbedded sand at the base, predominantly large-scale crossbedded sand in the middle, and finer-grained tidal flat and marsh sediment at the top. Inlets migrate depending upon such variables as rate of longshore sediment transport and depth of inlet. Inlet-fill contains coarse, bidirectional crossbedded sediments at the base, polydirectional crossbedded sands in the middle, and finer-grained aeolian sands at the top. (Small-FRC)  
W82-00792

**EFFECT OF PH AND REDOX POTENTIAL ON CONCENTRATION OF DISSOLVED NUTRIENTS IN AN ESTUARINE SEDIMENT,**  
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.

R. D. De Laune, C. N. Reddy, and W. H. Patrick, Jr.  
Journal of Environmental Quality, Vol 10, No 3, p 276-279, July/September, 1981. 2 Fig, 2 Tab, 17 Ref.

Descriptors: \*Nutrients, \*Marine sediments, \*Estuaries, \*Hydrogen ion concentration, \*Oxidation-reduction potential, Phosphorus, Carbon, Ammonia, Iron, Manganese, Sediments, Dissolved solids, Gulf of Mexico.

Although both sediment redox potential and sediment pH have been shown to affect the exchange

## Field 2—WATER CYCLE

### Group 2L—Estuaries

of nutrients at the sediment-water interface, most studies dealing with these effects have been theoretical in nature. This study investigated the combined effect of pH and redox potential on the concentrations of dissolved organic carbon, phosphorus, ammonia, iron, and manganese in an estuarine sediment in the Gulf of Mexico. Sediment suspensions were maintained under conditions of controlled pH (5.0, 6.5, and 8.0) and controlled redox potentials (-200, 0, 250, and 500 mV). Nutrient concentrations were found to be strongly influenced by changes in sediment pH and in redox potentials. Dissolved organic carbon increased from 42 micrograms per milliliter at pH 5.0 and 500 mV to 93 micrograms per milliliter at pH 8.0 and -200 mV. Decreasing sediment redox potential and pH resulted in increases in the concentrations of soluble phosphorus, ammonia, iron, and manganese. Phosphorus concentrations ranged from 0.002 micrograms per milliliter at pH 8.0 and 500 mV to 0.215 micrograms per milliliter at pH 5.0 and -200 mV. The concentrations of iron and manganese ranged from less than 0.1 micrograms per milliliter at pH 8.0 and 500 mV to 101 and 13 micrograms per milliliter, respectively, at pH 5.0 and -200 mV. The influence of sediment redox potential and pH on concentration gradients between interstitial and overlying water can result in fluxes of dissolved constituents to and from the sediment. The results of this study demonstrate the need to consider the influence of variables such as sediment redox potential and pH in models of the diffusion of chemical and biochemical reactive elements across the sediment-water interface. (Carroll-FRC)  
W82-00795

#### ESTIMATION OF MATERIAL FLUXES IN AN ESTUARINE CROSS SECTION: A CRITICAL ANALYSIS OF SPATIAL MEASUREMENT DENSITY AND ERRORS,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research. For primary bibliographic entry see Field 7A.  
W82-00816

#### THE ASSAY OF ADENOSINE 5'TRIPHOSPHATE EXTRACTED FROM SALT-MARSH MICROBIOTA,

South Carolina Univ., Columbia Dept. of Biology. L. H. Stevenson, C. A. Wilson, and T. H. Chrzanowski. Canadian Journal of Microbiology, Vol. 27, No. 6, p 633-635, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: \*Adenosine triphosphate, \*Salt marshes, Chemical analysis, Enzymes, Bacteria, \*Estuaries, Microorganisms, Marshes, Coastal waters, Tidal marshes, Aquatic life.

Data were collected to test the theory that the method employed to assay the adenosine 5'-triphosphate extracted from aquatic microbiota influences the temporal pattern of ATP density in the water of a salt-marsh creek. Water was collected from within the North Inlet Marsh, near Georgetown, SC. The sampling location monitored the major exchange point between the marsh and the Atlantic Ocean. Water was collected from 0.2 meters below the surface at 1.5 hr intervals comprising several tide cycles during February of 1979. The effect of the secondary emission pattern on the quantification of ATP was studied through 52 samples taken during the two expeditions. Assays using the integration approach produced values that were from 1.13 to 8.22 times higher than values determined by peak height analysis of the unfiltered samples and from 1.18 to 16.39 time higher in water that had been prefiltered by passage through a 1.0 micron filter. The latter samples contained bacteria as the only viable microbiota. ATP concentration values determined by integration averaged 3.6 times greater than values determined by peak height in the unfiltered samples and 4.8 times greater in the 1.0 micron filtered samples. Extracts prepared from biota in high-tide or oceanic waters did not have as great an enhanced secondary emission pattern as did extracts of samples collected at low tide. It would appear that bacteria were responsible for most of the enhanced secondary emissions observed in samples collected at or

near low tide. Thus the method used to assay ATP extracted from environmental samples markedly influences the data recovered. (Baker-FRC)  
W82-00838

#### ENRICHMENT OF THE AGRICULTURAL HERBICIDE ATRAZINE IN THE MICROSURFACE WATER OF AN ESTUARY,

Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies. For primary bibliographic entry see Field 5B.  
W82-00877

#### Dieback of Salt-Water Cordgrass (*Spartina alterniflora* Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-establishment,

North Carolina State Univ. at Raleigh. Dept. of Botany. R. A. Linthurst, and E. D. Seneca. Environmental Conservation, Vol 7, No 1, p 59-66, Spring, 1980. 6 Fig, 5 Tab, 39 Ref.

Descriptors: \*Spartina, \*Marsh plants, \*Plant growth, Vegetation, \*Estuaries, Ecosystems, Marshes, Wetlands, Plant communities, Salt marshes, \*Cape Fear Estuary, North Carolina.

Panne dieback of *Spartina alterniflora* in the Lower Cape Fear Estuary of North Carolina prompted a study, starting in 1975, of this phenomenon and the recolonization potential in the affected marshes. By September 1978 all three sites investigated (2 above and 1 below mean high water) had naturally recolonized by seeding, mainly *S. alterniflora*. Volunteers at the lower site were largely *S. alterniflora*; at the 2 higher sites, *Salicornia europaea*, *Distichlis spicata*, *Scirpus robustus*, and *Spartina patens* were also found. Experimental plots within each dieback site were regenerated most rapidly by volunteer plants transplanted from areas similar to the dieback sites and/or plants with large rhizome systems. It was concluded that this dieback was a short-term phenomenon and that natural recolonization, not man's re-vegetation attempts, was the major factor in reestablishment of the plants. (Cassar-FRC)  
W82-00889

#### EFFECTS OF TEMPERATURE, PH, SALINITY, AND INORGANIC NITROGEN ON THE RATE OF AMMONIUM OXIDATION BY NITRIFIERS ISOLATED FROM WETLAND ENVIRONMENTS,

University of West Florida, Pensacola. Dept. of Biology. R. D. Jones, and M. A. Hood. Microbial Ecology, Vol 6, No 4, p 339-347, 1980. 3 Fig, 24 Ref.

Descriptors: \*Nitrification, \*Oxidation, \*Ammonium, \*Estuarine environment, Nitrogen, \*Wetlands, Temperature, Salinity, Hydrogen ion concentration, Bacteria, Marshes, Sodium, Potassium, Nitrate, Nitrite, Nitrogen cycle, Cycling nutrients.

The transformation of nitrogen and its recycling are extremely important to the productivity of aquatic ecosystems. Although factors affecting ammonium oxidation in agricultural soils and sewage have been investigated, information on factors affecting nitrification in wetland environments is lacking. Ammonium-oxidizing bacteria were examined in a freshwater marsh and in an estuarine bay over a 2-year period. Two predominant species of *Nitrosomonas* were consistently isolated, one from each environment. A closed culture, high cell density assay was used to determine the effects of temperature, pH, salinity, sodium, potassium, nitrite, nitrate, and ammonium concentrations on nitrification. Maximum oxidation of ammonium by the freshwater isolate occurred at 35 degrees C, pH 8.5, salinities of 0.3 to 0.5 percent sodium and potassium, and ammonium concentrations exceeding 0.5 grams per liter. The estuarine isolate exhibited maximum activity at 40 degrees C, pH 8.0, salinities of 0.5 to 1.0 percent sodium and potassium, and 0.2 grams of ammonium per liter. The sodium requirement of the estuarine isolate could

be partially substituted by potassium, suggesting that the organism is a true estuarine bacterium. Salinities below 0.5 percent may severely reduce oxidation of ammonium by the bacterium in the estuarine environment. While nitrate had no significant effect on either isolate, certain combinations of ammonium/nitrite were inhibitory, especially to the estuarine species. The data indicate that oxidation of ammonium by isolates from wetlands is influenced by pH and temperature and that estuarine nitrifiers may be more sensitive to and more extensively affected by salinity, ammonium concentrations, and nitrite than are isolates from fresh waters. (Carroll-FRC)  
W82-00910

#### SEASONAL INFLUX AND DECOMPOSITION OF AUTOCHTHONOUS MACROPHYTE LITTER IN A NORTH TEMPERATE ESTUARY,

New Hampshire Univ., Durham. Jackson Estuarine Lab. M. N. Josselyn, and A. C. Mathieson. Hydrobiologia, Vol 71, No 3, p 197-208, June, 1980. 8 Fig, 4 Tab, 38 Ref.

Descriptors: \*Detritus, \*Aquatic plants, \*Decomposition, Estuaries, *Spartina*, *Zostera*, *Ascophyllum*, *Fucus*, Nutrients, Great Bay, New Hampshire, Maine, Coastal waters, Salt marshes, Marshes, Algae, Nitrogen, Phosphorus, Seasonal variation.

The seasonal contribution and detrital processing of autochthonous plant litter in the Great Bay Estuary system of New Hampshire and Maine was studied for 18 months. Monthly strand line collections at two inner estuarine sites and one open coast site provided information on the seasonal influx of litter derived from each species, the halophytes, *Spartina alterniflora* Loisel and *Zostera marina* L., and the seaweeds, *Ascophyllum nodosum* L. Le Jolis and *Fucus vesiculosus* L. v. spiralis Farlow. *S. alterniflora* detrital inputs were maximal in spring; *Z. marina* inputs, in summer. Seaweed litter was 35-85% of the total strand line throughout the year. In the estuary the seaweeds contributed 1 to 3 times as much detrital matter as did the vascular plants, on the open coast 50 times as much. Seaweeds decomposed 3-10 times faster than vascular plant litter (which contains more cellulose) under similar environmental conditions. Decomposition was faster under submerged conditions. Nutrient depletion occurred in litter within the strand line. N and P enrichment from microbial activity and rapid leaching of carbonaceous substrates were observed under submerged conditions. (Cassar-FRC)  
W82-00918

#### MICROBIOLOGICAL STUDIES OF A 'VIRGIN' SALT-FRESH WATER TRANSECT AT NORTH POINT, JAMES BAY, CANADA. I: BACTERIOLOGICAL ASPECTS,

Canada Centre for Inland Waters, Burlington (Ontario).

B. J. Dutka, and K. K. Kwan. Hydrobiologia, Vol 72, No 3, p 273-280, July 2, 1980. 8 Fig, 2 Tab, 12 Ref.

Descriptors: \*Baseline studies, \*Bacteria, Wetlands, Salt marshes, Marshes, \*James Bay, \*Canada, Water analysis, \*Microbiological studies, Sulfur bacteria, Eutrophication, Biomass, Saline-freshwater interfaces, Biodegradation, Sediments.

Bacterial populations were studied in water and sediment samples along a salt-fresh water shoreline transect at North Point, James Bay in northern Canada. Microbiological analysis showed that there was a very large microbial population, the greatest density occurring at the seawater stations. The few fecal indicator bacteria were a result of the animal population, not man's presence. Organic sulfur-reducing bacterial increased from 10,000 per 100 ml at the seawater stations to 100,000 per 100 ml at the brackish-fresh water interface. Sulfur-oxidizing bacteria varied from 10 to 100 per 100 ml, with highest densities in the marshland stations. Population patterns of ammonifying and denitrifying bacteria were quite similar to each other, with

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Use Of Water Of Impaired Quality—Group 3C

ammonifiers 10 times more plentiful than denitrifiers. At the sea stations ammonifiers were high and denitrifiers low, with peaks of both in the salt marsh area. The high bacterial and heterotrophic populations in the seawater stations indicate very eutrophic water. The potential biodegradation capacity of these waters is much greater than was formerly expected. (Cassar-FRC)  
W82-00921

**MICROBIOLOGICAL STUDIES OF A 'VIRGIN' SALT-FRESH WATER TRANSECT AT NORTH POINT, JAMES BAY II. MYCOLOGICAL ASPECTS,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
J. P. Sherry, and S. R. Kuchma.  
*Hydrobiologia*, Vol 74, No 2, p 113-117, September 1, 1980. 3 Fig. 13 Ref.

Descriptors: \*Fungi, \*Baseline studies, Wetlands, Marshes, \*James Bay, \*Canada, Water analysis, Sediments, \*Microbiological studies, Saline-freshwater interfaces.

Baseline values for fungi were determined along a salt-fresh water transect in the unperturbed North Point, James Bay, Canada, area. Fungi levels in water samples increased linearly from 28-70 CFU per 100 ml at the salt water end of the transect to 13,000-16,000 CFU per 100 ml at the fresh water end. In sediments the highest fungal densities were found inland at sites with rich, black organic sediments. Lowest fungi levels were found in sediments composed of clay and shingle fragments. (Cassar-FRC)  
W82-00922

**TRACE METAL FLUXES TO NEARSHORE LONG ISLAND SOUND SEDIMENTS,**  
New Hampshire Univ., Durham. Dept. of Earth Sciences.  
For primary bibliographic entry see Field 5B.  
W82-01040

### 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

#### 3A. Saline Water Conversion

**SUPERSEPARATION: SORET EFFECT REVERSED,**  
Scripps Institution of Oceanography, La Jolla, CA.  
Physiological Research Lab.  
H. T. Hammel, and J. E. Maggart.  
*Separation Science and Technology*, Vol 15, No 2, p 81-87, 1980. 1 Fig, 1 Tab, 2 Ref.

Descriptors: \*Desalination apparatus, \*Separation techniques, Soret effect, Osmotic pressure, Salt balance, Drinking water.

The Soret effect is attributed primarily to the fact that osmotic pressure is uniform across a solution when one side is heated and the other is cooled. When Whatman no. 40 filter paper was interspersed throughout an aqueous solution to minimize disturbance of the Soret effect caused by convection, the Soret effect was reversed. The concentration increased exponentially from nearly pure water at the cooled surface to many times the initial concentration at the heated surface. If the solution and filter paper were degassed, then the Soret effect was normal. It was concluded that microbubbles of air were entrained in the solution by the filter paper so that water vaporized on the warmer side of each bubble and condensed on the cooler side, thereby concentrating the solution near its heated surface and diluting it near its cooled surface. Continuous separation of seawater into potable water from the cooled surface was not possible in the described cell as the entrapped air in the filter paper was slowly absorbed by the condensate and removed from the cell. Continuous production of potable water was achieved, however, from a film of seawater flowing down a heated surface and supported a fraction of a millimeter

from a cooled surface on which the vapor condensed and drained into a collecting trough below. (Baker-FRC)  
W82-00791

#### 3B. Water Yield Improvement

**CONTROL OF WATER WEEDS BY GRASS CARP IN TWO SMALL LAKES,**  
Marine Dept., Rotorua (New Zealand). Fisheries Research Div.  
C. P. Mitchell.  
*New Zealand Journal of Marine and Freshwater Research*, Vol 14, No 4, p 381-390, 1980. 4 Fig, 19 Ref.

Descriptors: \*Weed control, \*Aquatic plants, \*Carp, \*Fish, Lakes, Plant growth, Waihi Beach Reservoir, Parkinsons Lake, \*New Zealand, Lake restoration.

Chinese grass carp (*Ctenopharyngodon idella* Val.), averaging 2 kg in weight, were incrementally stocked over a 3 year period in 2 small New Zealand lakes, Waihi Beach Reservoir, a water supply impoundment, and Parkinsons Lake, a eutrophic sand dune lake with no defined outlet. In Waihi Beach Reservoir a stocking density of 26 fish per ha resulted in a change in plant species dominance (due to preferential feeding) but no long term reduction of standing crop. A stocking density of 37-52 per ha was required to heavily reduce the aquatic vegetation over 2 summers. In Parkinsons Lake 37-44 carp per ha eliminated all vegetation by midsummer. The most palatable species were *Potamogeton* *ochreatus* and *Eleocharis* *sphaerulata*. At higher stocking densities, these and *Egeria densa* and *Nitella hookeri* were virtually eliminated. A more accurate estimate of weed removal rates would result if calculated on the basis of littoral zone area or number of aquatic plants. Since the degree of weed control depends on so many factors (plant growth, fish growth, mortality rates, water temperature, and standing crop), it is difficult to determine the optimum stocking density. Removal of stocked carp was difficult. However, this is necessary if aquatic weed control growths are to be managed rather than eliminated. (Cassar-FRC)  
W82-00609

**SEEDING-OPPORTUNITY RECOGNITION IN WINTER OROGRAPHIC CLOUDS,**  
Utah Water Research Lab., Logan.

G. E. Hill.  
*Journal of Applied Meteorology*, Vol 19, No 12, p 1371-1381, December, 1980. 14 Fig, 2 Tab, 18 Ref.

Descriptors: \*Cloud seeding, \*Weather modification, Moisture deficiency, \*Artificial precipitation, Rainfall, Cloud physics, Clouds, Temperatures, Orography, Orographic precipitation.

Basic meteorological parameters used to develop the present cloud seeding hypothesis for winter orographic storms are: cloud-top temperature, updraft speed, supercooled liquid water concentration, and precipitation rate. Analysis of supercooled water concentrations and precipitation as functions of cloud-top temperature and orographic updraft speeds indicates that seedability is marked by cloud-top temperatures from minus 22 degrees to zero degrees C and updraft speeds of 1 mile/second or greater. This hypothesis is substantiated by taking aircraft icing reports as representing supercooled water concentrations, and taking cross-barrier flow as representing vertical motion. The potential precipitation yield increases as the square of the cross-barrier wind speed increases within the suitable cloud-top temperature range. About 20% of the winter orographic clouds offer such high potential. High seedability is expected to be associated with post-frontal conditions where the cross-barrier flow is strong, high-level subsidence is occurring, and the moisture is still high at mountain top levels, or where weak low-level moisture systems are moving with strong airflow. (Baker-FRC)  
W82-01005

**VARIATIONS IN PRECIPITATION PARAMETERS BETWEEN DROUGHT AND NON-DROUGHT PERIODS IN TEXAS AND SOME IMPLICATIONS FOR CLOUD SEEDING,**  
National Weather Service Stoneville, MS.  
For primary bibliographic entry see Field 2B.  
W82-01006

#### 3C. Use Of Water Of Impaired Quality

**RECYCLING URBAN STORMWATER FOR PROFIT,**  
Environmental Protection Agency, Edison, NJ.  
R. Field, and C-Y. Fan.  
*Water/Engineering and Management*, Vol 128, No 4, p 30-33, April, 1981. 2 Fig, 6 Tab, 25 Ref.

Descriptors: \*Storm runoff, \*Reclaimed water, \*Water reuse, \*Urban runoff, Storm water, Combined sewer overflows, Wastewater treatment, Industrial water.

Current urban storm water control and treatment technology leading to its reuse in industrial cooling and processes, irrigation, and recreational water supply are presented. Although storm water pollutant concentration varies with time and location during a storm and from one storm to another, the BOD<sub>5</sub> is usually close to that of municipal sewage secondary effluent, and the suspended solids concentration is similar to that of raw sanitary wastewater. Combined sewer overflow quality lies between that of untreated sanitary sewage and urban storm runoff. Physical treatment units are more effective than biological systems because they can handle the highly variable flow rates and pollutant concentrations. The treatment chosen depends on the desired use: low level treatment for irrigation water and high level treatment for boiler feed water. A table lists four categories of waters, AA, A, B, and C, with the maximum concentrations of metals, anions, color, etc., allowed for each classification. A hypothetical case study of a 100 acre industrial complex illustrates the planning process. After the demand and quality requirements in each category of water quality are decided, storage and treatment facilities are designed for each class of water. Next, costs are determined. Three reuse alternatives are compared: all city water, all storm water except for potable water, and all storm water except for potable water and process water. The cheapest alternative in this case reuses stormwater for irrigation process and cooling water and gives a total water supply cost of \$1.54 million, saving \$800,000 over the use of city water for these purposes plus for potable water. (Cassar-FRC)  
W82-00524

**EFFECTS OF MUNICIPAL WASTE WATER EFFLUENT ON PERFORMANCE AND FEED QUALITY OF MAIZE VS. REED CANARYGRASS,**  
Science and Education Administration, St. Paul, MN.

G. C. Marten, W. E. Larson, and C. E. Clapp.  
*Journal of Environmental Quality*, Vol 9, No 1, p 137-141, January-March, 1980. 5 Tab, 9 Ref.

Descriptors: \*Wastewater farming, \*Crop yield, \*Corn, Grasses, Wastewater irrigation, Wastewater disposal, Crop production, Forages, Feeds, Fodder, Proteins.

The field quality and yields of dry matter, digestible dry matter, and crude protein of maize and reed canarygrass were determined when fields were managed for maximum yield and when irrigated with two levels of municipal wastewater effluent. The three treatments of plots were a control consisting of well water and mineral fertilizer, application of 5 cm of wastewater per week, and application of 10 cm of water per week. In the second through fourth year, the maize fodder was more digestible than any of the reed. The reed canarygrass always contained more crude protein than the maize. Seventeen to 36% more dry matter and 23 to 41% more digestible dry matter was yielded by the maize fodder. These differences

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3C—Use Of Water Of Impaired Quality

were reduced as effluent applications increased. Reed canarygrass yielded from 30 to 52% more crude protein per hectare. Thus, perennial grasses seem to have a superior capacity when compared to maize for removing nitrogen from soil treated with wastewater effluent. The grasses yielded the most protein per hectare but the least digestible dry matter when treated with effluent. (Small-FRC)  
W82-00564

**ISOLATION AND IDENTIFICATION OF PATHOGENIC MICROORGANISMS AT WASTEWATER-IRRIGATED FIELDS: RATIOS IN AIR AND WASTEWATER,**  
Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.  
For primary bibliographic entry see Field 5A.  
W82-00579

**IRRIGATION AND DRAINAGE WATERS OF A NEW IRRIGATION ZONE IN THE HUNGRY STEPPE AND POSSIBILITIES OF THEIR USE,**  
V. A. Molodtsov.  
Water Resources (English Translation), Vol 7, No 5, p 422-430, September/October, 1980. 1 Fig, 5 Tab, 5 Ref. Translated from Vodnye Resursy, No 5, p 89-99, September/October, 1980.

Descriptors: \*Irrigation, \*Drainage waters, \*USSR, Hungry Steppe, Water demand, Chemical analysis, Mineralization, Flushing, Chemical composition, Asia, Salts, Saline soils.

An acute shortage of fresh water resources is developing in Central Asia as a result of increasing irrigation. The mineralization and chemical composition of rivers of Central Asia, especially the Syr Darya, have changed significantly since the 1950s. The increased mineralization of the Syr Darya is primarily the result of the inflow of drainage waters from the Fergana Valley. The possibility of using waters having increased mineralization for flushing saline soils has commanded considerable interest as the need for fresh water sources has become more acute. The mineralization and chemical composition of irrigation and drainage waters of the newly irrigated zone in the Hungry Steppe were observed monthly for three years in an effort to determine their suitability for use in flushing operations. These studies indicated that the use of drainage waters for flushing salinized soils was feasible in three regions of the Hungry Steppe. The waters of the Central Hungry Steppe Collector Drain (CHD) could be used for flushing the area confined to the Dzhetyasai and Sardobin depressions, which contain meadow solonchaks with more than 2 percent toxic salts in the upper 1 meter layer. Drainage waters from group collector drains can be used for flushing areas in the southeastern part of the Hungry Steppe, including parts of the Khavast alluvial fan and the eastern part of the Dzhizak Steppes. Waters of Central Collector Drain No. 7 can also be used to flush the peripheral territory of the Khavast alluvial fan. The waters of the collection drains of the Khavast alluvial fan and the CHD can be used to flush the territory of the Khavast alluvial fan adjacent to the Sardobin depression. Drainage waters in the territory of the Dzhizak'min part of the Dzhizak Steppes could conceivably be used for flushing if vertical drains were constructed and well discharges were large. Drainage waters in the rest of the Hungry Steppe are not suitable for flushing soils in their vicinity. (Carroll-FRC)  
W82-00658

**EFFECT OF IRRIGATING LOAMY SAND SOIL BY LIQUID SEWAGE SLUDGE ON ITS CONTENT OF SOME MICRONUTRIENTS,**  
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.  
For primary bibliographic entry see Field 5E.  
W82-00661

**THE EFFECTS OF SODIUM AND ORGANIC MATTER IN SEWAGE EFFLUENT ON WATER RETENTION PROPERTIES OF SOILS,**  
The Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Science.  
S. Burns, and E. Rawitz.

Soil Science Society of America Journal, Vol 45, No 3, p 487-493, May-June, 1981. 7 Fig, 3 Tab, 17 Ref.

Descriptors: \*Soil moisture retention, \*Wastewater irrigation, Soil properties, Effluents, \*Organic matter, \*Sodium, Moisture availability, Irrigation, Infiltration.

A set of laboratory experiments conducted to test effects of sewage effluent on the water relations of soil under simulated drop irrigation is presented. Soil used was taken from two separate depths at Kfar Kayarok in the Israeli Coastal Plain. Under the conditions of this study, no amount of sewage water approximately equivalent to one season's irrigation in the field was sufficient to increase the soil's capacity to retain water. No ponding occurred, and aerobic conditions were maintained. Allowing the soil to dry a few days between irrigations was the determining factor in preventing ponding. When using effluent for crop irrigation, as opposed to utilizing cropland for effluent disposal, the intermittent wetting and drying regime is the more representative of field conditions. Effluent sodium adsorption ratio (SAR) was instrumental in increasing the amount of water held by deflocculating the soil. Soil drying enhanced organic matter-clay complex formation between soil clay colloids and the organic solids introduced by the sewage effluent. In finer soil, these complexes were fairly stable and produced cracking in the surface which can be useful in field water management. In coarser soil less stable, organic matter-clay complexes were formed, which were easily destroyed by simulated rain application, resulting in redispersion and soil-pore blockage by organic colloids. (Baker-FRC)  
W82-00663

**THAMES REARS CARP IN SEWAGE.**  
Water, No 38, p 38, May, 1981.

Descriptors: \*Fish farming, \*Wastewater, Water reuse, Fish stocking, Fisheries, Fish, Carp, Wastewater lagoons, Lagoons, England.

Sewage treatment lagoons have been stocked annually with excess stocks of small fry, and these are cropped 12 months later when they have reached about 17 cm in length. This creates a secondary function for the lagoons, the rearing of fish for which all the feed is provided by the effluent, and yet which achieve a marketable value in one year. Five hundred Kg. of quality rough fish have been removed from the Stanford lagoons by sewage operators and divisional scientific staff using the electro-fishing method. Before being distributed, the fish are given a thorough health check. The screening is very thorough, as these fish then go on to healthy fisheries. A random sample from each batch is checked for any irregularities. (Baker-FRC)  
W82-00681

**SALINE WATER USE AND DISPOSAL OPPORTUNITIES: COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM,**  
Bureau of Reclamation, Boulder City, NV.  
Special Report, September, 1981. 153 p, 20 Fig, 31 Tab, 50 Ref, 4 Append.

Descriptors: \*Saline water, \*Impaired water use, \*Cooling water, \*Waste water disposal, Coal slurry pipelines, Saline water systems, Industrial water, Fuel, Solar energy, \*Colorado River basins.

Saline concentrations in the Colorado River are increasing and will continue to increase as the Basin States develop their lands and available water resources. Without a program of salinity control, continued development will result in increased damages to agricultural, municipal, and industrial users. An assessment was made of the potential technical and economic feasibility of collecting saline water in the Colorado River Basin, transporting it for practical use in energy production, and exporting and disposing of wastewater in a cost-effective manner. Sixteen saline water sources were evaluated in various collection configurations for local use or export. The total water

volume considered as potential sources for use or disposal is 610,000 acre-feet. Efforts were directed to highlighting opportunities of using saline water in powerplant cooling and industrial processing as well as coal slurry pipelines. The most promising beneficial use cases appear to be: local use of saline water for powerplant cooling; and a coal slurry pipeline carrying 50 or 100 million tons of coal per year to southern California using saline water as the transport medium. Other potential uses include salt gradient solar ponds for desalting and power generation. Wastewater and blowdown collection and disposal service were also examined for energy development sites located near saline water pipeline collection systems. If a long-distance pipeline is developed for other purposes, economies of scale may make wastewater collection and disposal a viable alternative. (Moore-SRC)  
W82-00717

**QUALITY OF IRRIGATION WATER AND EFFECTS OF SULFURIC ACID AND GYPSUM ON SOIL PROPERTIES AND SUNDANGRASS YIELDS,**

Arizona Univ., Tucson Dept. of Soils, Water, and Engineering.  
B. J. Alawi, J. L. Stroehlein, E. A. Hanlon Jr, and F. Turner Jr.  
Soil Science, Vol 129, No 5, p 315-322, May, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: Saline soils, \*Sulfuric acid, \*Gypsum, \*Irrigation effects, Irrigation water, \*Soil properties, \*Crop yield, Infiltration rate, Sudangrass.

A study is presented which was designed to show the effects of continuous irrigation with water of different qualities on soil properties and crop yields. Also, the extent to which relatively low rates of sulfuric acid and gypsum can be used beneficially to reduce soil salinity and sodium and improve infiltration rates and crop yields was determined. Plots were irrigated over a three year period with water which had a salinity content varying from ECw of 3.2 times 10 to the 3rd power to 0.55 times 10 to the 3rd power millimhos/cm. Different soil salinities resulted, and the exchangeable sodium percentage ranged from 18.4 to 24.0 in the surface 30 cm of soil. Over a two year period, Sudangrass yields increased with decreasing water salinity after the addition of relatively low rates of H2SO4 and gypsum. Yields were increased by H2SO4 and gypsum with all three waters the first year, but only by H2SO4 the second year. Thus, sulfuric acid was generally superior to gypsum for reducing soil salinity and exchangeable sodium percentage. (Small-FRC)  
W82-00767

**2,500 ACRES OF WASTEWATER IRRIGATION,**  
J. F. Blair.  
BioCycle, Vol. 22, No 3, p 30-31, May/June, 1981.

Descriptors: \*Irrigation water, \*Wastewater irrigation, Water reuse, Agriculture, Pipelines, Water conveyance, Water storage, Lubbock, Texas.

Near Lubbock, Texas, 7.2 mgd of treated wastewater pumped through a 16 mile pipeline will irrigate 2500 acres of cropland. At the end of the 27 inch watertight pipeline are three 15 inch lines leading to earthen storage lagoons, each 50-100 acres in area and 13 ft in depth. From the lakes, water is pumped through center pivot sprinkler systems. It is expected that cotton production will increase to 1.5 bales per acre from the nonirrigated yield of 0.5 bales per acre. Forty years' experience with wastewater irrigation on the nearby 4,000 acre Gray farm have shown that seepage never reached below 15 ft and did not enter the Ogallala aquifer. (Cassar-FRC)  
W82-00769

**GROWTH OF THE BAY SCALLOP, ARGOPEC-TEN IRRADIANS, IN A WASTE RECYCLING AQUACULTURE SYSTEM,**  
 Woods Hole Oceanographic Institution, MA.  
R. Mann, and R. E. Taylor Jr.  
Aquaculture, Vol. 24, No. 1/2, p 45-52, May, 1981. 2 Fig, 1 Tab, 14 Ref.

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Conservation In Agriculture—Group 3F

Descriptors: \*Water recovery, \*Aquaculture, \*Recycling, Mollusks, \*Aquatic animals, \*Scallops, Wastewater treatment, Water quality, Growth, Impaired water use.

This report presents results of studies of the growth of Argopecten irradians both in a pilot scale waste recycling aquaculture system, and in laboratory systems at four temperatures when fed on phytoplankton cultured in sewage-seawater mixtures. Juvenile A. irradians were grown successfully on a diet of phytoplankton cultured in sewage-seawater mixtures. A. irradians increased from initial live and dry meat weights of 1.15 g and 0.043 g respectively, to terminal values of 9.08 g and 0.599 g, respectively. This corresponds to instantaneous growth rates for live weight and dry meat weight of 0.009 and 0.013, respectively. High mortalities were evident towards the end of the experiment, with a terminal value of 33%, giving an instantaneous mortality rate value of 0.0016. In laboratory experiments of 12 weeks in length at 12, 15, 18 and 21 degrees C, juvenile A. irradians gave values of 0.01, 0.013, 0.018, and 0.016 for live weight, 0.015, 0.015, 0.016, and 0.013 for dry weight and 0.038, 0.038, 0.037 and 0.040 for instantaneous mortality rate at the respective temperatures. A. irradians exhibited specific growth rates comparable to or higher than those previously recorded for other bivalve species cultured in waste recycling systems. However, a considerable reduction in the presently high mortality rate will be needed to make A. irradians a prime candidate for practical application. (Baker-FRC)  
W82-00842

**MASSIVE CULTIVATION OF MICROALGAE: RESULTS AND PROSPECTS,**  
Kernforschungsanstalt Juelich (Germany, F.R.)  
Inst. fuer Biotechnologie III.  
For primary bibliographic entry see Field 5D.  
W82-00913

**ENVIRONMENTAL EFFECTS OF WATER REUSE SCHEME,**  
Sewage Reclamation Dept., Tel Aviv (Israel).  
E. Idelovitch.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 561-570, June, 1980. 4 Fig, 4 Tab, 7 Ref.

Descriptors: \*Wastewater renovation, \*Environmental effects, \*Water reuse, \*Israel, Water supply, Water demand, Water resources development, Water treatment facilities, Wastewater treatment.

Due to the scarcity of water supplies in Israel, it is not feasible to discharge wastewater into the sea. First, such discharge would be environmentally unsound. Second, the wastewater should be treated for reuse as a source of supply for agricultural, industrial, and even municipal consumers. The Dan Region Project in the Tel Aviv Metropolitan Area is the largest and most advanced water reuse scheme in Israel. The first stage of the project, now in operation, comprises facilities for advanced treatment and groundwater recharge of wastewater discharged from the Southern Tel Aviv Metropolitan Area. These facilities serve a total population of about 400,000 and have a capacity of 20,000,000 cubic meters per year or about 15 mgd. The second part of the project deals with wastewater from the northern and eastern parts of the Tel Aviv Metro Area. Prior to the completion of the first stage, most of the wastewater which is now treated had been discharged into the Mediterranean Sea. The water now undergoes biological and physicochemical treatment, and is then recharged to the groundwater aquifer by intermittent spreading over sand basins. The reclaimed water will be used to supplement nonpotable needs. The oxidation ponds in the first stage remove settleable solids, sand, suspended solids, soluble biodegradable matter, nitrogen, and heavy metals, within a process of algae growth. A high lime-magnesium process removes suspended solids, bacteria, viruses, and some inorganic dissolved solids. The polishing ponds provide for stripping of free ammonia at high pH and for recarbonation of the lime

treated effluent by absorption of carbon dioxide. (Baker-FRC)  
W82-00973

#### EFFECTS OF WATER QUALITY ON FORAGE PRODUCTION,

Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.  
R. E. Zartman, T. D. Miller, J. R. Goodin, and M. Gichuru.  
Journal of Environmental Quality, Vol 9, No 2, p 187-190, April/June, 1980. 4 Tab, 15 Ref.

Descriptors: \*Cooling water, \*Irrigation effects, \*Forages, Irrigation water, Water quality, Crop yield, Alfalfa, Municipal water, Water reuse, Electric powerplants, Crop production, Lubbock, Texas.

The effects of water quality on forage production were investigated in a 4-yr field study conducted at the Jones Station Facility in Lubbock, Texas. Three application rates (high, medium, and low) of electric powerplant cooling water and city water were used to irrigate fourwinged saltbush (*Atriplex canescens*) and alfalfa (*Medicago sativa*) stands started on a Friona fine sandy loam in 1975. Alfalfa crops reacted favorably to irrigation, with the highest yields occurring in the high-irrigation city water treatment, followed by the high irrigation blowdown water treatment. Alfalfa stands receiving medium irrigation levels produced moderate yields, while the dryland production decreased during the course of the experiment. Irrigation had little effect on yields of Atriplex stands. No differences in forage yield were found between fields irrigated with city and cooling water. It was concluded that alfalfa production benefits by irrigation with either blowdown or city water. (Geiger-FRC)  
W82-01002

#### HEALTH ASPECTS OF URBAN WATER CONSERVATION,

East Tennessee State Univ., Johnson City. Dept. of Environmental Health.  
C. S. Bishop, and V. A. Sikora.  
Journal of Environmental Health, Vol 42, No 5, p 250-252, March/April, 1980. 1 Ref.

Descriptors: \*Water demand, \*Conservation, Water supply, Water supply development, \*Water reuse, Potential water supply, Water shortage, \*Public health, Urban areas.

The nature, potential scope and limitations of the federal urban water conservation program in relationship to environmental health are considered. As demand for additional water supplies grows, conservation becomes increasingly important. Environmental health professionals must help insure that a comprehensive approach will be taken and that forthcoming innovations will not jeopardize the public health. Approaches to decrease the consumption of water include reducing pressure in the distribution system, use of water saving devices, reducing leakage, in-home wastewater recycling systems, and increased water prices. Each of these possibilities has potential problems which must be understood before they are undertaken. A great deal of controversy exists concerning reusing wastewater in the home. The concept of a split system in which water used for washing is then used for toilet flushing is interesting. However, it may lead to cross connection and the potential for contaminated water to enter the potable water supply, creating a health hazard for a large number of people. Any such water saving devices will probably be installed as a novelty and will not be used uniformly throughout a system. They may then be misused by subsequent owners of a home or by tenants. Building inspectors view this as a potential problem. (Baker-FRC)  
W82-01047

#### 3E. Conservation In Industry

##### GROUND-WATER USE FOR COOLING: ASSOCIATED AQUIFER TEMPERATURE CHANGES,

California Univ., Berkeley. Lawrence Berkeley Lab.  
M. J. Lippman, and C. F. Tsang.  
Ground Water, Vol 18, No 5, p 452-458, September/October, 1980. 4 Fig, 3 Tab, 11 Ref.

Descriptors: \*Cooling water, \*Injection wells, \*Electric powerplants, Aquifer management, Powerplants, \*Water conservation, Thermal pollution, Heated water, Groundwater.

Water and energy conservation could result if cooling waters from a steam-electric plant are injected into an aquifer for later use in heating, industry, or agriculture. This paper analyzed a simple system comprising one withdrawal and one injection well and concluded that, at rates of 3.65 million cu meters per year, the wells are usable for 2 to 8 years before the temperature of the extracted water becomes too hot to produce a cooling effect. In actual field use a much larger number of wells would be used, extending the life of the well field. The heating effects in confined aquifers are localized around the injection wells. When well operation ceases, the hot water plume drifts in the direction of the groundwater flow, gradually cooling. (Cassar-FRC)  
W82-01014

### 3F. Conservation In Agriculture

#### SALINE IRRIGATION WATER.

World Farming, Vol 23, No 1, p 24, January/February, 1981.

Descriptors: \*Saline water, \*Irrigation practices, \*Sprinkler irrigation, Water injury, Water pollution effects, Salt tolerance, Irrigation efficiency.

Sprinkling irrigation water during the evening or night can reduce leaf salt absorption by half compared with daytime sprinkling. Irrigation should be infrequent and heavy, with sprinkler rotations of 1 min or less to prevent drying between cycles. As little as 200 ppm of salts in irrigation water can injure crops if leaves accumulate salt. Furrow or flooding irrigation causes less salt injury than sprinkler irrigation for the more sensitive crops: citrus, stone fruit trees, almonds, peppers, potatoes, tomatoes, alfalfa, barley, safflower, sesame, and sorghum. (Cassar-FRC)  
W82-00512

#### YIELD AND WATER USE OF VEGETABLE CROPS WITH SEEPAGE AND DRIP IRRIGATION SYSTEMS,

Agricultural Research and Education Center, Bradford.

A. A. Czisnizky.  
Florida Scientist, Vol 43, No 4, p 285-292, Fall, 1980. 1 Fig, 6 Tab, 6 Ref.

Descriptors: \*Irrigation efficiency, \*Vegetable crops, \*Water use efficiency, Corn, Broccoli, Squash, Drip irrigation, Seepage, Crop yield, Water conservation, Conservation.

The effects of seepage and drip irrigation on crop yield were studied in spring 1978 on broccoli (*Brassica oleracea* L., Italica Group cv. 'Green Comet Hybrid'), sweet corn (*Zea mays* cv. 'Silver Queen'), and zucchini squash (*Cucurbita pepo* cv. 'Fordhook'). Yields per plant in kg (seepage and drip, respectively) were: broccoli, 0.307 and 0.198; corn, 0.191 and 0.189; and zucchini, 6.13 and 6.32. Plant densities for seep irrigation were 70-85% of the densities for drip irrigation. Yields per hectare in tons (seepage and drip, respectively) were: broccoli, 3.76 and 3.15; corn, 10.68 and 12.14; and zucchini, 45.21 and 60.67. Seepage irrigation plots received water at a constant rate of 13.31 liters per sq meter per day, and the amount of water with the drip system was adjusted every 10 days. Total amounts of water received during the growing season in liters per sq meter (seepage and drip, respectively) were: broccoli, 752 and 216; corn, 978 and 355; and zucchini, 1124 and 359. Water use (in liters) to produce 1 kg of marketable yield were: broccoli, 1999 and 684; sweet corn, 916 and

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### Group 3F—Conservation In Agriculture

193; and zucchini, 249 and 59, for seepage and drip irrigation, respectively. (Cassar-FRC)  
W82-00544

#### TRAVELING SPRINKLER SYSTEM AND METHOD.

Toro Co., San Marcos, CA. (Assignee).

E. J. Hunter.

U.S. Patent No. 4,204,642, 33 p, 43 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1260-1261, May 27, 1980.

Descriptors: \*Patents, \*Irrigation systems, \*Sprinkler irrigation, \*Application equipment, Irrigation efficiency, Irrigation practices, Irrigation operation and maintenance.

A low capital investment system for irrigating a relatively large area field, comprises a mobile base, and a sprinkler mounted on the base and adapted to accumulate water from a water supply and to intermittently discharge the accumulated water in a stream over the field. Apparatus is provided for propelling the base in a back and forth movement traversing a field, and for generally reversing the water discharge direction each time the direction of travel is reversed. The sprinkler includes a resiliently expandable reservoir construction for accumulating relatively large volume, intermittent bursts, and a drive system which also provides relatively short range, continual irrigation. Separate sprinkler units can be used on a field concurrently, or a single unit can be moved over successive areas of a field until the whole field has been covered. The system may also be combined with a center pivot device to irrigate land that would otherwise be unused. (Sinha-OEIS)  
W82-00561

#### RESEARCH AND DEVELOPMENT TO SERVE A SUSTAINABLE AGRICULTURE,

University of New England, Armidale (Australia).

J. R. McWilliam.

Search, Vol 12, No 1/2, p 15-21, January/February, 1981. 5 Fig, 16 Ref.

Descriptors: \*Research priorities, \*Irrigation efficiency, \*Dry farming, Irrigation, Water use efficiency, Water management, Water resources development, \*Australia.

Important problems which threaten the stability of Australia's irrigated and dry-land cropping systems are considered and the most urgent research needs are identified. The originality and effectiveness of research depends upon the quality of students and the agricultural education available to them. A successful utilization of Australia's water and soil resources depends on efficient conservation and management practices. Research is needed in the area of irrigation. Most of the water resources are located in the north, where only about 5% of available water is utilized. In the south, where irrigation is used, there are problems with the buildup of salinity and the deterioration of structure in fine-textured soil under intensive cropping. Efficient water management is especially important in areas which employ dryland cropping. Research is needed on the effects of tillage, including no-till, minimum tillage, and various forms of stubble retention and mulching. Research is also needed in crop development, pest and pathogen control, and the establishment of pastures. (Small-FRC)  
W82-00669

#### OPERATIONAL EVALUATION OF VILLAGE LEVEL IRRIGATION CONVEYANCE SYSTEMS.

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.

T. J. Trout, and S. A. Bowers.

Transactions of the ASAE, Vol 24, No 3, p 636-642, May/June, 1981. 9 Fig, 5 Tab, 7 Ref.

Descriptors: \*Conveyance structures, \*Water loss, \*Irrigation ditches, Water conveyance, Leakage, Irrigation operation, Mathematical studies, Design criteria, \*Pakistan.

In a study of five village level watercourse systems in Pakistan, total operational conveyance losses

were measured using an adaptation of the inflow-outflow method. The extents of transient losses were quantified, as were the types of watercourse losses, to aid in the evaluation of conveyance efficiencies. Flow rates were monitored continuously, and flow hydrographs were created. Operational losses were calculated as the difference between the volume of water entering the watercourse at the head and the volume entering the irrigated fields. Total losses varied from 37 to 56%, and averaged 45% on inflow. Fifty-five percent of the losses occurred on the primary channels. Less than 1% of the losses were attributed to evaporation, and loss rates decreased with distance. Seven percent of the inflow or 15% of the losses were due to transient phenomena such as wetting dry channels, dead storage, and short-term breaches. Steady-state seepage into channel wetted perimeters was much greater than would be expected from normal infiltration. (Small-FRC)  
W82-00696

#### LAND FORMING EFFECTS ON DRYLAND SORGHUM PRODUCTION IN THE SOUTHERN GREAT PLAINS,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab. O. R. Jones.

Soil Science Society of America Journal, Vol 45, No 3, p 606-611, May-June, 1981. 4 Fig, 5 Tab, 10 Ref.

Descriptors: \*Crop yield, \*Cultivation, Soil moisture retention, Soil water, Moisture availability, Agriculture, Erosion, Water conservation, \*Sorghum, Runoff control, \*Land forming.

Research was conducted to develop low-cost land forming systems for controlling or reducing storm runoff on drylands and to determine the effectiveness of selected land forming systems in preventing runoff, controlling erosion, storing water, and increasing grain sorghum yields. Various land forming treatments investigated included conventional graded furrow, conventional contour furrow, wide furrow, Orthman, mini-bench, and conservation mini-bench. All plots were tandem-disked about 0.07 meters deep in early April each year to bury residue and allow volunteer sorghum to sprout. Furrow treatments were imposed in early May. Conventionally constructed contour furrows on large fields frequently overtop during heavy, high-intensity rainstorms. Overtopping and subsequent soil erosion from runoff results when the surface-water storage capacity of furrows or border dikes is exceeded. Orthman, wide furrow, mini-bench, and conservation mini-bench treatments did not overtop but retained all precipitation from this record rainstorm because their surface-water capacity was not exceeded. Thus level land forming systems can effectively conserve precipitation and prevent runoff on large, gently sloping field areas in the Southern Great Plains. Water is the limiting resource for crop production in the area. Approximately one half of the total water requirements for a dryland sorghum crop can be provided from soil water stored at seeding time. Land leveling is the most effective conservation practice for preventing runoff and increasing dryland crop yields. (Baker-FRC)  
W82-00764

#### EFFECT OF SOIL WATER CONTENT AND A GROWING SEASON STRAW MULCH ON GRAIN SORGHUM,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab. P. W. Unger, and O. R. Jones.

Soil Science Society of America Journal, Vol 45, No 1, p 129-134, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: \*Mulching, \*Sorghum, \*Soil water, Straw, Mulches, Crop production, \*Crop yield, Water use efficiency, Soil moisture retention.

A study was performed to evaluate the contribution of a growing season straw mulch to grain sorghum growth, yield, grain quality, water use, and water use efficiency. Plots of Pullman clay loam were given two irrigations, one irrigation, and no irrigation prior to planting in order to

simulate high, medium, and low levels of water storage in soil during fallow. Zero, 2, 4, or 8 metric tons of wheat straw per hectare were placed on the surface after the sorghum emerged. Sorghum responses to the high and medium water storage levels were similar, since the second irrigation resulted in relatively little additional storage due to the slow permeability of the soil. However, sorghum on plots receiving one or two irrigations grew taller, yielded more, and used water more efficiently than water on unirrigated plots. In general, sorghum responded more to soil water content at planting than to mulch rate during the growing season. Over a three year period, application of 8 metric tons of straw per hectare during the growing season resulted in a 19 percent increase in water use efficiency over plots receiving no mulch. Shading from the plant canopy appeared to provide the beneficial effect of a mulch during the growing season. A major beneficial effect of using a mulch during both the fallow and the growing seasons, in terms of water conservation and crop production, is the enhancement of water storage in the soil during fallow periods. (Carroll-FRC)  
W82-00765

#### LASER DRIP IRRIGATION.

World Farming, Vol 23, No 1, p 34, January/February, 1981.

Descriptors: \*Irrigation engineering, \*Trickle irrigation, \*Lasers, Water conservation, Computers.

An experimental laser-guided traveling trickle irrigation system features a main tower which keeps field towers in alignment with the use of a laser plane. Laser receptors in each field tower activate changes in motor speed to adjust the alignment. Water is applied near the plant, wasting none between rows. Future plans include computer programming and solar power. This system can eliminate over-irrigation, uneven distribution of water in soil, and excessive labor costs. (Cassar-FRC)  
W82-00771

#### EVALUATING IRRIGATION SYSTEMS,

For primary bibliographic entry see Field 6B.

W82-00772

#### WATER STRESS AND COLD HARDINESS IN FIELD-GROWN CITRUS,

Florida Univ., Gainesville. Dept. of Fruit Crops.

For primary bibliographic entry see Field 21.

W82-00864

#### SIZING RICE IRRIGATION CANALS,

D. P. Spare, J.-K. Wang, and R. E. Hagan.

Transactions of the ASAE, Vol 23, No 4, p 914-918, 923, July/August, 1980. 1 Fig, 3 Tab, 3 Ref.

Descriptors: \*Rice, \*Irrigation canals, \*Design criteria, Flood irrigation, Cropland, Canals, Irrigation design, Mathematical studies, Mathematical equations.

The peak demand for irrigation water in a paddy rice production system, which occurs at the beginning of a production season when land soaking water is introduced, determines the sizes of irrigation canals needed. Three conflicting requirements must be suitably reconciled if this peak water demand is to be minimized. First, the system-wide water demand during the land soaking period should follow as closely as possible the theoretical minimum values proposed by Hagan and Wang (1977). Second, the minimum land area to be served by a given sublateral or farm-ditch during a rotational period should not be less than that determined by local circumstances. Third, the patterns of subdivision of the project area into command and service areas to be served by laterals and farm ditches which are dictated by topographical and sociological constraints should be respected. A procedure for the design of sublateral in-field irrigation water distribution systems for paddy rice production systems which reconciles these three requirements is presented. The procedure minimizes the peak water requirement of the produc-

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Conservation In Agriculture—Group 3F

tion system and gives a detailed irrigation schedule for the land soaking period. The procedure has been applied to the design of the Naga-Cabanga Integrated Agricultural Development Area project, a 7,000 hectare paddy rice production system in the Philippines. (Carroll-FRC)  
W82-00895

#### WATER REQUIREMENT FOR SUGARCANE PRODUCTION, Agricultural Research and Education Center, Belle Glade, FL.

S. F. Shih, and G. J. Gascho.  
Transactions of the ASAE, Vol 23, No 4, p 934-937, July/August, 1980. 4 Fig., 3 Tab., 19 Ref.

Descriptors: \*Crop production, \*Water requirements, \*Sugarcane, Sugar crops, Water use, Rainfall, Lysimeters, Soil water, Soil-water-plant relationships.

The only economically feasible strategy for increasing the longevity of the organic soils of the Everglades, which are subsiding at a rate of between 1.5 and 3.1 centimeters per year, is to maintain high water tables. However, available data on the effect of water table level on water requirement and production performance of sugarcane are not adequate for making precise recommendations as to optimum water table depth for sugarcane production and soil conservation. Six lysimeters were used to control water tables at 30, 60, and 90 centimeters below the muck soil surface for sugarcane production. The effective rainfall was found to be proportional to water table depth, with about 3.4 centimeters of rainfall stored in the soil for each 10-centimeter increment of water table depth. Water table depth had a significant effect on water requirement in both the dry and the grand growth periods. Each 10-centimeter increase in water table depth resulted in a reduction in the water requirement of about 3.7 centimeters for plant crop and 2.2 centimeters for ratoon crop during the dry season and about 3.4 and 1.3 centimeters, respectively, during the grand growth period. Maintaining a high water table will increase the requirements for water for irrigation and the need for pumping for drainage following heavy rainstorms. The water required to produce 1 kilogram of fresh cane varied from 89 kilograms in plant crops to 118 kilograms in the ratoon crop. Water requirements for production of 1 kilogram of sugar ranged from 884 kilograms in plant crop to 1115 kilograms in ratoon crop, indicating lower water use efficiency by ratoon crop. (Carroll-FRC)  
W82-00989

#### DEPTHS OF FLOW IN LEVEL BASINS, Science and Education Administration, Phoenix, AZ. Water Conservation Lab.

A. J. Clemmons.  
Transactions of the ASAE, Vol 23, No 4, p 910-913, July/August, 1980. 1 Fig., 1 Tab., 7 Ref.

Descriptors: \*Water depth, \*Basins, \*Flow rates, Border irrigation, Irrigation, Infiltration, Mathematical studies, \*Basin irrigation, Level basins.

The design of level basins is based on balancing the infiltration characteristics of the soil, the basin size, and the available irrigation stream (flow rate). Since the use of the largest possible stream available can cause excessive surface water depths in some cases, the design of level basins can also be dependent upon a practical limit on basin ridge or border height. A solution for the maximum surface water depth in level basins was developed from the zero-inertia border irrigation model developed by Strelkoff and Katopodes (1977). This model is based on continuity and momentum principles. The solution is applicable to rectangular basins irrigated from one end where the application time is less than the advance time to the end of the basin. A direct comparison of the solution results with the design charts in the Soil Conservation Service Border Irrigation Handbook demonstrates that the solutions presented in these charts can be in error by as much as 20 percent within a realistic range of field variables. (Carroll-FRC)  
W82-00900

#### THE UNCERTAINTY OF CROP MODELS IN IRRIGATION OPTIMIZATION, Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.

M. J. English.  
Transactions of the ASAE, Vol 24, No 4, p 917-921, July/August, 1981. 6 Fig., 2 Tab., 10 Ref.

Descriptors: \*Model studies, \*Irrigation practices, Crop yield, Simulation, Weather, \*Optimization, Irrigation efficiency.

This paper is concerned with economic optimization of irrigation practices. Optimization is taken to mean maximizing the net benefit realized from the unit of water used. Crop production models are considered which relate applied water to crop yield. It is noted that the relationship between the water applied and crop yield is characterized by substantial and largely unavoidable uncertainty, which may be so great as to influence a farmer's irrigation practices. A case study is presented in which the uncertainty of yield predictions is simulated for a situation involving irrigation of beans and sugar beets in southern Idaho. The consequences of that uncertainty are evaluated through the use of decision theory. A need for a probabilistic approach to crop modelling is demonstrated. Weather conditions are unpredictable. Irrigation efficiency is another source of considerable uncertainty. Crop models are needed which not only predict most probable yields, but also quantify the uncertainty in yield predictions. New models will need to emphasize statistical simulation techniques, and since statistical simulation usually involves large blocks of computer time, these models should be designed with computational efficiency in mind. The related research in agronomy, meteorology, soil science and engineering should be as concerned with variability of results as with central tendencies. Researchers concerned with water use and crop yield models need to develop an understanding of the practical applications of the variability and uncertainty of such models. (Baker-FRC)  
W82-00940

#### LATERAL SIZES FOR EFFICIENT LEVEL-BASIN IRRIGATION,

Agricultural Research Service, Fort Collins, CO. E. G. Kruse.

Transactions of the ASAE, Vol 24, No 4, p 961-967, 969, July/August, 1981. 3 Fig., 4 Tab., 2 Ref.

Descriptors: \*Irrigation practices, \*Computer programs, Irrigation efficiency, Level basins, Irrigation programs, Irrigation canals, \*Grand Valley, Colorado.

A procedure is described whereby a computerized data base of irrigated fields in a section of the Grand Valley was sorted to determine those fields with deep enough soils and mild enough slopes for practical basin leveling. Level-basin irrigation is an old technique for applying water to the land for the benefit of crops. There is no runoff in such a situation, and crops such as rice are easily kept inundated. Pilot studies demonstrated that with proper management, irrigation water can be applied efficiently and good crop production obtained. The computer screens data on physical characteristics of irrigated fields and then uses Soil Conservation Service design procedures to predict the necessary irrigation flows for efficient level-basin applications. The United States Water and Power Resources Service is formulating designs for improved canals, laterals, and turnouts in a pilot area of the Grand Valley. The computer program compared required delivery rates for level-basin irrigation with turnout capacities, based on existing WPRS criteria. Those turnouts which need enlargement were thus identified. Arrangements were negotiated with WPRS to increase the sizing on critical turnouts. If level-basin procedures continue to show promise of increased irrigation efficiencies and if they are adopted widely on the pilot area, this procedure will receive widespread use in planning for the remainder of the Grand Valley and other irrigated areas in the upper Colorado River Basin. (Baker-FRC)  
W82-00942

#### WATERABLE MANAGEMENT SAVES WATER AND ENERGY, Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.

L. C. Benz, E. J. Doring, and G. A. Reichman.  
Transactions of the ASAE, Vol 24, No 4, p 995-1001, July/August, 1981. 4 Fig., 7 Tab., 15 Ref.

Descriptors: \*Irrigation efficiency, \*Water table, Crop yield, Water table fluctuations, Water level fluctuations, Lysimeters, Groundwater movement, Farming, Corn, Sugarcane, Water conservation, \*North Dakota.

Water and energy savings possible by maintaining shallow water tables were investigated. The field experiment was conducted near Oakes, North Dakota, on soils of the Heceta-Arvenses-Fossum Association. Soil textures range from sandy loams to loamy sands in the surface but have uniformly sandy subsoils. Corn and sugarbeets were grown for 3 years with four applied water treatments, three imposed water tables, and four replications. As it was impossible to maintain the water table at prescribed depths in the field experiment, twelve nonweighing lysimeters were constructed near the field plot experiment. In the field plot studies where the growing season 3-year average water tables were 1.5, 2.1, and 2.4 meters deep, yields of corn grain, corn total dry matter, sugarbeet roots, and sugarbeet sucrose were higher with the 1.5 meter water table than with the deeper water tables irrespective of irrigation water applied. Thus irrigation water and energy were wasted where the shallow water table existed. For the 2.1 and 2.4 meter water table depths, irrigation increased yields, but maximum yields never exceeded yields obtained with the shallow water tables. The lysimeter studies included a wider range of water table depths than field plot experiments. At the shallowest water table, crop yields were depressed. Regression analyses of normalized field and lysimeter data indicated that maximum yields were obtained with much less irrigation water when the water table depth was about 1.3 meters than with deeper water tables. It was concluded that a managed shallow water table is a valuable agricultural resource that can save significant amounts of irrigation water and energy. (Baker-FRC)  
W82-00943

#### DRYLAND CROPPING STRATEGIES FOR EFFICIENT WATER-USE TO CONTROL SALINE SEEPAGE IN THE NORTHERN GREAT PLAINS, U.S.A.,

Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.

A. L. Black, P. L. Brown, A. D. Halvorson, and F. H. Siddoway.  
Agricultural Water Management, Vol 4, No 1/3, p 295-311, 1981. 5 Tab., 41 Ref.

Descriptors: \*Water supply development, \*Crop-land, \*Salinity, Farming, Wheat, Sunflower, Alfalfa, Water quality, Groundwater, Water resources development, Soil water, \*Seepage control, \*Soil-water-plant relationships.

Soil, water, and crop management strategies needed for the control of saline seepage are identified. These strategies are based on the specific water requirements and rooting depths of crops, soil water conservation and storage, crop residue management, disease and weed control and proper fertilization. Specific strategies considered include water conservation, cropping systems, weed control and residue management. Several conclusions were reached. The practice of summer fallowing a given field every other year restricts a farmer to a fixed cropping system with limited flexibility for adjusting cropping patterns to fit available water supplies. Summer fallow should be used judiciously instead of as a regular practice. Of great importance is an understanding of the quantity and depth of available water stored within the effective rooting zone in the recharge area to be cropped. Once the quantity and depth of available soil water are known, the crop best suited to a given supply of water can be selected. On deep soils, alfalfa can remove more soil water than any other adaptable crop in a 3 to 5 year period to depths of 6 meters if no root restricting factors are present. Second in

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

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soil water use is biennial sweet clover. Of annual crops, safflower uses the most, followed in order by sunflower, winter wheat, rapeseed, spring wheat, spring barley, and corn. After available soil water is depleted to the maximum depth possible, a flexible cropping system can be employed. Methods of weed control plus provisions for snow management, leaving crop stubble standing or establishing tall wheatgrass barrier systems to trap and hold snow, all augment available water supplies. (Baker-FRC)  
W82-01023

### 4. WATER QUANTITY MANAGEMENT AND CONTROL

#### 4A. Control Of Water On The Surface

SUBMERSIBLE PUMPS HELP QUELL DAMAGE FROM MOUNT ST. HELENS MUD-FLOW.  
For primary bibliographic entry see Field 4D.  
W82-00509

##### AQUATIC WEED CUTTING APPARATUS, J. R. McClure.

U.S. Patent No 4,205,507, 13 p, 8 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 995, No 1, p 44, June 3, 1980.

Descriptors: \*Patents, \*Aquatic weed control, \*Equipment, \*Channel improvement, Floating, Water quality control, Weed cutter.

A floating aquatic weed cutting apparatus is disclosed which is highly maneuverable and particularly useful for cutting along banks and around obstacles. The cutter bar is entirely outward of one of the lateral sides of a flotation device. The cutter bar may be moved about an axis parallel to the central axis of the flotation device to change the angular disposition of it for cutting along submerged banks and around obstacles in the water. The entire cutter may be elevated with respect to the flotation device to raise or lower it from or into the water. (Sinha-OEIS)  
W82-00624

THE CASPIAN SEA PROBLEM,  
Akademika Nauk SSSR, Moscow. Inst. Vodnykh Problem.  
D. Ya. Ratkovich.  
Water Resources (English Translation), Vol 7, No 5, p 393-402, September/October, 1980. 4 Tab, 20 Ref. Translated from Vodnye Resursy, No 5, p 5-20, September/October, 1980.

Descriptors: \*Caspian Sea, \*Water resources development, \*Resources management, Water management, Planning, Management planning, River basin development, Irrigation, Hydroelectric power, Salinity, Fisheries, Hydrologic budget, Mathematical studies, Interbasin transfers.

The Caspian Sea is the world's largest closed water body, collecting water from an area of about 3 million square kilometers. The Volga River accounts for about 75% of the total natural inflow to the sea. Although the average salinity of the sea is stable, that of the North Caspian, which is freshened by the runoff from the Volga, varies considerably. The various branches of the economy place conflicting demands on the regime of the Caspian and of the rivers flowing into it. Planned irrigation projects will decrease the runoff of the Volga, Kura, and Ural rivers, reducing the energy produced by hydroelectric stations and the depth of navigation channels. Efforts to maintain the water flow for these purposes necessitates reduction of the height and duration of floods, which will adversely affect spawning conditions of sturgeon. Reduction of the inflow into the sea results in increased salinity and may induce a drop in the water level. The water management balance of rivers of the Caspian basin is already under stress.

The planned diversion of waters to the Volga from rivers and lakes of the northern European U.S.S.R. should be correlated with the rate of development of irrigation in order to preserve the unique biological productivity of the sea, to prevent the unfavorable effect of drying of the North Caspian on the climate, and to reduce losses which would result from a drop in the water level of the sea. Diversion of small amounts of water from the Volga to the Ural river would have favorable effects on the North Caspian, freshening its waters and enriching its biogenic substances. Changes which will occur in the natural conditions in zones from which water is withdrawn, and problems which may result from these changes, should be carefully considered when planning interbasin water transfer projects. (Carroll-FRC)  
W82-00657

##### BACKFILL ALTERATION EFFECTS ON PIPE DRAINAGE OF A CLAY SOIL, Ohio Agricultural Research and Development Center, Wooster.

G. S. Taylor, S. S. Hundal, N. R. Fausey, and G. O. Schwab.  
Soil Science Society of America Journal, Vol 45, No 3, p 611-616, May-June, 1981. 5 Fig, 12 Ref.

Descriptors: \*Subsurface drainage, \*Backfill, Permeability, Clays, Infiltration, \*Drainage, Effects, \*Pipes, Drawdown.

A highly permeable region was created directly over drains installed a number of years earlier in a soil of high clay content in order to determine the effect of a highly permeable backfill on drain flow rates and to assess how long the backfill would remain highly conductive under continuous row cropping. Backfill treatments included unaltered backfill; gravel backfill, in which a trench excavated above the drain was filled with a band of crushed stone placed between plow layer and drain; or trenched and refilled, in which the trench excavated above the drain was refilled with excavated soil. The effects of backfill treatments on drain flow indicated that a permeable backfill may improve drainage for soils that have a slowly permeable subsoil. The addition of gravel increased drain flow rates by a factor of two to three during periods of ponding, but had no effect on flow rates under nonponded conditions nor on water table drawdown rates. The ponded flow rates for drains with gravel have not changed after 3 years. During the first year trenching and refilling had the same effect on drain flow rates as gravel. During the second year, the ponded flow rates declined to only 50 or 60% of those with gravel. The permeable backfill functioned as a hydraulic connector and permitted ponded water to bypass the relatively impermeable subsoil in flowing to the drain. Backfill alterations did not affect sediment concentrations in the drain water. (Baker-FRC)  
W82-00763

##### MODELING HYDROLOGY AND EUTROPHICATION IN A LOUISIANA SWAMP FOREST ECOSYSTEM, Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.

C. S. Hopkinson Jr. and J. W. Day Jr.  
Environmental Management, Vol 4, No 4, p 325-335, July, 1980. 5 Fig, 1 Tab, 16 Ref.

Descriptors: \*Swamps, \*Storm water, \*Environmental effects, Model studies, Coastal marshes, \*des Allemans, \*Louisiana, \*Eutrophication, Hydrology, Wetlands, Urbanization, Lakes, Drainage canals, Nutrients, Levees, Productivity, Estuaries, Swamp forest, Water management.

The EPA Storm Water Management Model was applied to the des Allemans swamp forest, Louisiana, to determine (1) the hydrologic changes that would result from removal of spoil banks and diversion of major agricultural canals and (2) the effects of overland flow on nutrient uptake in the ecosystem. At present, the swamp becomes impounded and discharge from the forest to the lake is slow. Simulations showed that hydraulic management could increase discharge rates to the lower estuary by 22%, increase productivity of the

swamp forest by 100%, and decrease lake eutrophication by 43%. Contrary to commonly held beliefs, the results suggest that these changes can be accomplished by removing levees and upland drainage canals. This would allow upland runoff to pass through the backswamp, often as sheet flow, increasing water level fluctuations in the backswamp and decreasing fluctuations in the bayous. (Cassar-FRC)  
W82-00890

### 4B. Groundwater Management

PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON,  
Geological Survey, Boise, ID. Water Resources Div.  
For primary bibliographic entry see Field 6A.  
W82-00730

INTERSTATE CONFLICT OVER GROUND WATER: WISCONSIN-ILLINOIS,  
Wisconsin Univ.-Oshkosh. Dept. of Geology.  
For primary bibliographic entry see Field 6E.  
W82-00818

THE DECLINING GROUND-WATER RESOURCES OF ALLUVIAL VALLEYS: A CASE STUDY,  
Geological Survey, Lawrence, KS.  
M. Sophocleous.  
Ground Water, Vol 19, No 2, p 214-226, March/April, 1981. 5 Fig, 14 Ref.

Descriptors: \*Groundwater depletion, \*Groundwater budget, \*Water conservation, Mathematical models, Depiction, Artificial recharge, Groundwater recharge, Case studies, \*Kansas.

Present and future ground water withdrawals in the area of the Pawnee Valley, Kansas, were evaluated for their impact on water resources. The depletion of the water resource in the area is documented, and a preliminary hydrologic budget for the area is calculated. Also, a mathematical model is adapted and calibrated to simulate the operation of the hydrogeologic system in order to evaluate schemes for managing the ground water resource. The average natural recharge in the area was 0.5 inch/year, and the amount of appropriated ground water in the area exceeded the natural recharge figure by about 11 times. The simulations indicated that without any additional development or without very wet periods, water level declines will continue indefinitely. To reduce water depletion it will be necessary to reduce water waste, to impose a not more than 40% saturated-thickness depletion allowance for the next several years, to impose a freeze on the number of irrigation wells, and to engage in artificial recharge. (Small-FRC)  
W82-00832

TAMPA BAY WATER GUARDED BY COMPUTER,  
Camp, Dresser and McKee, Inc., Clearwater, FL.  
R. N. Armstrong, and H. V. Aiken.  
American City and County, Vol 96, No 6, p 33-35, June, 1981. 1 Fig.

Descriptors: \*Water demand, \*Water resources development, Wells, \*Florida, Computers, Computer models, Computer programs, Drawdown, Water supply, Water supply development, Water distribution, Monitoring, \*Groundwater management, Groundwater availability, \*Tampa Bay region.

Use of a specialized, innovative computer management system has succeeded in maximizing the precious water resources on the west coast of Florida in the Tampa Bay region. The computer monitors, manages, and protects groundwater sources so that critical short-term and long-term water supply demands can be met. By quickly analyzing real-time information, the monitoring and control system developed for the Cross Bar Ranch well field greatly enhances the ability of the operator to

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Groundwater Management—Group 4B

respond to real-time conditions in the well field. In the past it may have taken several days of trial adjustment to fine tune pumping rates to bring a well field into compliance with regulatory permits. With this system wells can be connected or disconnected rapidly as demand shifts. A model was also derived for surge analysis. While surge analysis is not new, the surge model for the Cross Bar ranch field is the most complex yet devised. This system makes possible an effective analysis of the complex system of 17, three mgd wells. It also enhanced the sizing of surge tanks throughout the well field to minimize pressure waves generated by the starting and stopping of pumps. Use of the surge model saves an estimated \$70,000-\$80,000. (Baker-FRC) W82-00934

#### MANAGEMENT OF RECHARGE BASINS ON THE SOUTHERN HIGH PLAINS,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab. O. R. Jones, D. W. Goss, and A. D. Schneider.

Transactions of the ASAE, Vol 24, No 4, p 977-980, 987, July/August, 1981. 2 Fig, 4 Tab, 8 Ref.

Descriptors: \*Recharge basins, \*Resources management, Recharge, Groundwater recharge, \*Water management, Infiltration rate, Infiltration, Groundwater movement.

Management practices were developed for recharge basins which would prevent sealing, reduce suspended solids accumulated on the basin bottom, or permit rapid removal of the sealing layer without a drying period. These practices would increase total quantity of water infiltrated and thereby reduce the cost of artificial groundwater recharge. Six 9.1 meter square basins were excavated 1.1 meters deep with a backhoe to remove slowly permeable surface soil and expose permeable Pleistocene age pluvial sediments. These exposed sediments had a clay loam texture with moderately blocky structure and a high calcium carbonate content. Basin surface treatments and management practices for each basin included: check treatment, organic mat, flocculent, high head, variable head, and corrugated. Results showed that infiltration rates were controlled at or near the basin bottom. Suspended solids in the water supply accumulated on the basin bottom and reduced infiltration rates with time. Management practices that prevented or delayed clay-layer formation at the basin bottom were effective in maintaining high infiltration rates longer, which resulted in greater total infiltration per unit area of basin surface. Infiltration rates and total quantity of water infiltrated were highest with the high-head treatment. Application of cotton gin trash to the basin surface was another effective management practice. Total infiltration per unit area of basin surface was able to be more than doubled by using improved management practices. The combination of high-head with either the organic mat or flocculent treatment could result in even greater recharge effectiveness than any of the treatments alone. (Baker-FRC) W82-00938

#### WELL-FIELD DRAWDOWNS USING COUPLED AQUIFER MODEL,

Law Engineering Testing Co., Tampa, FL.  
For primary bibliographic entry see Field 2F.  
W82-00990

#### ROLE OF SOLUTE-TRANSPORT MODELS IN THE ANALYSIS OF GROUNDWATER SALINITY PROBLEMS IN AGRICULTURAL AREAS,

Geological Survey, Reston, VA.  
For primary bibliographic entry see Field 5B.  
W82-00993

#### ILLINOIS GROUNDWATER PROBLEMS AND NEEDS,

Illinois Environmental Protection Agency, Springfield, Div. of Land/Noise Pollution Control.

J. S. Moore.  
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 13-14.

Descriptors: \*Groundwater management, \*Groundwater pollution, \*Waste disposal, \*Coal mining, Groundwater availability, Hazardous materials, Grants, Technology, Administrative agencies, Administrative regulations, Policy making, Public opinion, Public participation, \*Illinois.

Use of underground water for public and private supplies, industrial use, and irrigation is increasing in Illinois. Approximately 38 percent of the total state population and 82 percent of the rural population relied on an underground water source for drinking water as of 1970. A wide variety of activities can lead to groundwater pollution, including waste disposal sites; improper well construction; land application of potential pollutants such as fertilizers, pesticides, and road salt; mining and quarrying; individual sewer systems; and transportation of hazardous wastes. Various control strategies are possible. Illinois should: (1) examine state agency jurisdiction to identify over laps or gaps in existing regulations; (2) examine the role of non-regulatory and scientific entities in the state to ensure coordination between such programs; (3) increase public awareness of the importance of groundwater as a valuable natural resource and identify existing public values and perceptions of underground water; (4) encourage public participation in program direction and development; (5) utilize the interagency groundwater task force to increase cooperation among involved state agencies on groundwater related strategies, determine the availability of data to decision-makers and identify technological practices; and (6) continue development of a comprehensive groundwater quality management program. Funds and technology-sharing must be sought from the federal government. (Garrison-Omniplan) W82-01052

#### GROUNDWATER POLLUTION IN KENTUCKY: A STATUS REPORT,

Kentucky Dept. for Natural Resources, Frankfort. J. C. Thornton.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 17-21, 2 Fig, 5 Ref.

Descriptors: \*Groundwater pollution, \*Groundwater management, Water pollution, Karst, \*Waste disposal, Hazardous materials, Poisons, Groundwater availability, Sinks, Septic tanks, Seepage pits, Underground streams, Drinking water, \*Water pollution control, \*Kentucky.

The Commonwealth of Kentucky has had a number of problems with contaminated groundwater, particularly related to improper waste disposal practices and to problems in oil and coal fields. Many of the existing major problem areas are located within the state's widespread areas of jointed, fractured limestone, which is very susceptible to the formation of solution channels and sinkholes. This kind of topography, known as karst, covers almost 50 percent of the state and is replete with underground streams and caves. Underground streams are particularly sensitive to contamination because they flow in channels that have a much higher velocity than normal groundwaters, and receive little or no filtration from the rock. If the contamination is stopped, these systems will flush out quickly, but in most cases the sources of contamination are relatively permanent. The major drinking water source throughout the largely rural karst area is groundwater. The Department for Natural Resources and Environmental Protection's Division of Water began assessing groundwater quality problems under the auspices of Section 208 of the Clean Water Act, and learned that one of the major causes of groundwater pollution in the state is improperly designed septic tanks and seepage pits. Other causes are sediment, agricultural chemicals, septic tank loadings, surface mining, oil and gas production, brine disposal, construction activity, and spills. Principal needs of the Division include quality research data for each aquifer, more trained personnel for groundwater management, and regulation for groundwater monitoring, well construction, and subsurface disposal. (Garrison-Omniplan) W82-01053

#### GROUND WATER IN THE OHIO RIVER BASIN PORTION OF MARYLAND: PROBLEMS AND NEEDS,

Maryland Dept. of Natural Resources, Annapolis. E. C. Rebuck.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, P 22-26.

Descriptors: \*Surface-groundwater relations, \*Groundwater management, Federal jurisdiction, \*Administrative regulations, State jurisdiction, \*Aquifer management, Administrative agencies, Groundwater depletion, Groundwater level, Acid mine drainage, Mine acids, Hydrologic models, \*Ohio River basin, \*Maryland, Garrett County.

The Ohio River Basin portion of Maryland lies wholly within Garrett County, an area rich in minerals where the primary surface water resources are the Youghiogheny River and the Casselman River. While the two rivers have been shown to have good water quality, smaller tributaries do not meet stream water quality standards due to acid mine drainage pollution. Springs are important sources of domestic and municipal ground water supplies in the county. Hydraulic connection between the streams and ground waters is poorly understood. The U. S. Geological Survey is pursuing a modeling study in the Casselman River Basin which will attempt to correlate base stream flow with ground water levels. On the state level, programs for ground water protection are administered by the Department of Water Resources and the Department of Health and Mental Hygiene. On the federal level, the Environmental Protection Agency is involved with activities covered by the Resources Conservation and Recovery Act of 1976, the Underground Injection Control Program in the Safe Drinking Water Act (SDWA), and the sole source aquifer protection program of SDWA. Perhaps the most important technical need is the updating of the 1954 water resources reported by the USGS. Another need is better coordination among federal and state environmental regulatory efforts, especially now in times of tight economic conditions where environmental control budgets may be cut at both federal and state levels. (Garrison-Omniplan) W82-01054

#### GROUNDWATER PROBLEMS AND NEEDS IN NEW YORK,

New York State Dept. of Environmental Conservation, Albany. A. C. Tedrow.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 27-29.

Descriptors: \*Groundwater management, \*Drinking water, \*Groundwater availability, \*Groundwater pollution, Research priorities, Administrative agencies, \*Administrative regulations, Waste disposal, Water management, Reclaimed water, State jurisdiction, Local governments, Brine disposal, \*New York.

A Groundwater Task Force convened in 1979 by the New York State Department of Environmental Conservation examined in-house groundwater management programs. Among its conclusions were that: (1) not enough is known about the resource itself, specifically with regard to current quality levels; (2) monitoring of changes in groundwater quality is adequate, so that violations of groundwater quality standards are often not discovered until they have created a problem; (3) oil and gas and mined land reclamation programs in the Department are understaffed, so that groundwater impacts of the activities they regulate receive insufficient attention; (4) the Department should support local efforts in managing groundwater; (5) research is needed on groundwater reclamation and renovation; (6) Department personnel must be trained to be more sensitive to groundwater concerns, and technical staff must be developed to deal with groundwater questions; (7) a

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4B—Groundwater Management

classification system should be considered that includes fresh groundwater uses other than drinking water; (8) the possibility of utilizing wasteload allocations for discharges to groundwater should be explained; and additional groundwater management activities are required in the upstate area. Under the 208 program, projects are underway to investigate the technical, institutional, and financial aspects of changes in groundwater management, to develop better controls over underground storage of hazardous materials, and to investigate pesticide and fertilizer application practices in relation to groundwater quality. In the Ohio River Basin area, there are problems with high nitrate levels and brine disposal. (Garrison-Omniplan)  
W82-01055

#### GROUNDWATER PROBLEMS IN NORTH CAROLINA,

North Carolina Dept. of Natural Resources and Community Development, Raleigh.

P. F. Nelson.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 30-31.

Descriptors: \*Groundwater management, Public opinion, \*Deep wells, \*Groundwater availability, \*Legislation, State jurisdiction, Attitudes, Administrative agencies, Long-term planning, Multiobjective planning, Surface-groundwater relations, Boreholes, "North Carolina".

Planning for developing groundwater resources is not currently a very sophisticated process in North Carolina. Although much work has been done in the past to describe the hydrologic characteristics of the Coastal Plain aquifers, very little is known about the development potential in the Piedmont and mountain regions. Lack of knowledge of the availability of the resource, and widespread misunderstanding of groundwater on the part of the public, has resulted in its under-utilization in many areas. A hesitancy to drill deep wells prevails, although there is mounting evidence that contrary to public opinion, 600- and 700-foot wells are often extremely more productive than the borehole drilled to 175 feet. North Carolina's needs with respect to groundwater protection and wise management are: (1) recognition of the need for a comprehensive groundwater program; (2) prompt statewide implementation of the Groundwater Classification and Quality Standards; (3) an effective Water Well Contractor Licensing Board to examine and approve operators as well as contractors; (4) improved groundwater management legislation, as the existing Act is cumbersome to employ and has the potential of creating a 'patchwork quilt' of water management areas. The need to become more involved in groundwater research in the fractured rock terrain is becoming more and more critical as Piedmont cities exhaust their available surface water resource. (Garrison-Omniplan)  
W82-01056

#### OHIO'S GROUND WATER RESOURCES AND PROBLEM AREAS,

Ohio Environmental Protection Agency, Columbus. Groundwater Div.

R. B. Stein.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 32-33.

Descriptors: \*Groundwater availability, \*Groundwater management, \*Groundwater pollution, Water pollution, Wells, Waste disposal, Poisons, Multiobjective planning, Water use, Competing use, Long-term planning, Legislation, State jurisdiction, Administrative regulations, Public policy, \*Ohio.

Ohio's ground water reserves, while abundant, are unequally distributed. Ground water quantity problems can be attributed to cyclic drought conditions. Conflicts between groundwater users have been noted in a number of areas and are usually the

result of well interference between two or more large users or one large user affecting water levels in nearby shallow wells. For the most part, the problems have been resolved voluntarily by adjusting pumping rates and schedules, or by developing additional production wells beyond the area of pumping interference. Ohio, being a densely populated and highly industrial state, generates large volumes of both liquid and solid wastes. Based upon groundwater complaint investigations conducted by the Ohio EPA over the past eight years, the most prevalent ground water contamination problems are from domestic on-lot sources affecting private individual wells. Contamination has most often been the direct result of poor well construction and maintenance, or improper well abandonment. Other leading causes of contamination have been salt water effects related to oil and gas production or improperly plugged oil wells, and coal leaching effects. Ohio's major concerns in ground water program planning are to define agency roles and coordination, determine staff capability and training, develop public education and awareness, and increase data collection and regulatory practices. (Garrison-Omniplan)  
W82-01057

#### PENNSYLVANIA GROUND WATER PROBLEMS AND NEEDS,

Pennsylvania Dept. of Environmental Resources, Harrisburg.

R. T. Weston.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 34-40.

Descriptors: \*Groundwater management, \*Long-term planning, \*Groundwater availability, \*Groundwater pollution, Water pollution, Coal mining, Data collection, Administrative regulation, \*Legislation, Public policy, State jurisdiction, Drinking water, Multiobjective planning, \*Pennsylvania.

Over half of Pennsylvania's public water supply systems obtain all their water from ground water aquifers, and another 13 percent meet part of their demands with ground water. Potentials for conflict among competing water users are growing. As water needs grow, ground water will fill an increasing part of the demand. Ground water planning is hampered by limited use data and incomplete hydrogeologic information, but several problem areas have been identified. Some Triassic basins are extremely susceptible to drought, and recharge slowly after heavy withdrawal. Interference between public and private withdrawals, such as overlapping cones of depression between neighboring wells or pumping operations, is another problem area. Mining operations frequently de-water large areas. In water quality preservation, problem areas include malfunctioning on-lot sewage systems, inadequately designed or operated waste disposal facilities, leaking storage tanks and pipelines, transportation accidents, poorly operated agricultural activities, roadways and parking lots where runoff infiltrates the ground, past or current mining, and oil and gas recovery operations. Acid drainage from bituminous coal mining is a problem in some areas. Pennsylvania has no comprehensive legal or institutional approach to water allocation. Common law often operates contrary to hydrologic fact, treating interrelated ground and surface water resources under separate and inconsistent rules. State authority to regulate water allocation is extremely narrow. A reform of State water management policy is proposed, and fourteen major goals are outlined. (Mantius-Omniplan)  
W82-01058

#### GROUND WATER PROBLEMS VIRGINIA PORTION OHIO RIVER BASIN,

Virginia State Water Control Board, Richmond.

A. H. Giles.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 42-62. 16 Fig.  
W82-01060

Descriptors: \*Groundwater management, River basins, Geohydrology, \*Groundwater pollution, Water pollution, \*State jurisdiction, Rivers, Groundwater availability, Underground stream, Coal mining, Aquifers, Aquifer management, Aquifer characteristics, \*Ohio River basin, \*Virginia.

The area drained by the headwaters of several Ohio River tributaries in southwestern Virginia covers three geologic/physiological provinces with somewhat rugged terrain, some broad valleys and moderate climate and rainfall. Generally ground water is abundant and of good quality but hard in the limestone aquifers of the Valley and Ridge Province. In the flood plain alluvium of the Valley and Ridge and Piedmont it is moderately abundant, and in the Piedmont, Valley and Ridge and Cumberland Plateau's soils and rocks other than limestone it is of relatively small yield. Faulting and fracturing enhances production. Some surface pollution has been reported in limestone aquifers in the Valley and Ridge, which are especially susceptible to pollution. In the Cumberland Plateau, ground water pollution and loss of supply potentially are associated with natural gas and coal extraction activities, and most deeper aquifers are naturally salty. Metal mining elsewhere threatens ground water quality. The most serious pollution problems throughout the area are from petroleum product storage tank leaks and spills, waste facilities, and local urbanization. Effects of salt water and gas invasion have been observed in the Cumberland Plateau. The State Water Control Board has been effective in local pollution response, waste facility evaluation and well site evaluation. For most of the area, ground water information is minimal, but in some areas, county-wide ground water reports are being published. (Garrison-Omniplan)  
W82-01059

#### GROUND WATER PROBLEMS IN WEST VIRGINIA,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.

J. Northeimer.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 63-75. 1 Fig, 2 Tab, 2 Append.

Descriptors: \*Groundwater management, \*Groundwater pollution, Water pollution, State jurisdiction, \*Administrative regulations, Public policy, Drinking water, \*Legislation, Federal jurisdiction, Groundwater availability, Long-term planning, Multiobjective planning, \*West Virginia.

Approximately 53 percent of the population of West Virginia obtains drinking water from ground water sources; however, historically there has been very little effort devoted to its protection and maintenance. Although the state ground water protection program is still in the developmental stage, participation in the various federal programs addressing ground water is providing the necessary resources for an effective regulatory framework. As the state assumes authorization for implementing these programs, the proper management of ground water will become a reality. Major limiting factors in the development of an adequate ground water management program at the state level are poorly developed control programs authorized under state statute, no central or coordinating regulatory approach or strategy, lack of initiative under the 106 program, no comprehensive monitoring network, no regulatory control over ground water development, and lack of adequate state-level funding. Statutory changes are currently being pursued at the state level to allow state implementation of federal programs which address ground water protection and maintenance, such as the Hazardous Waste Management Program under the Resource Conservation and Recovery Act, and the Underground Injection Control Program under the Safe Drinking Water Act. (Garrison-Omniplan)  
W82-01060

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Watershed Protection—Group 4D

#### MATHEMATICAL MODELING TECHNIQUES FOR GROUNDWATER MANAGEMENT, Prickett (Thomas A.) and Associates, Urbana, IL. T. A. Prickett.

In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 97-104. 170 Ref.

Descriptors: \*Mathematical models, \*Groundwater management, \*Data collections, \*Model studies, Hydrologic models, Hydrologic data collections, Digital computers, Computers, Multibjective planning, Long-term planning, Decision making, Data acquisition, Numerical analysis.

Mathematical modeling has served an important role in groundwater management. Mathematical groundwater models provide a broad range of techniques for analysis of groundwater problems, including not only sophisticated numerical techniques solved with digital computers but analytical formulas worked out with desk calculators, type curves, and a table of well functions. Despite the dominance of numerical model development in the 1970s, new analytical formulas continue to be found in the recent literature. Numerical and analytical models developed to date are impressive. Also, computational devices are readily available in all ranges of price and capability. However, progress is needed that involves (1) making present and future models more useful by adequately documenting codes and procedures for their application (2) developing a large group of models aimed at solving problems in the range of simple to moderate complexity; and (3) developing models and techniques that produce results that managers can understand. Based on a survey on modeling inadequacies conducted by Bachmat (1978), the major problem with existing groundwater models was that few are documented sufficiently to be useful. The development of more simple and moderately complex models should also be keyed to quick evaluation of many alternatives. A group of educational materials is needed to help managers understand the purposes, capabilities, and results of mathematical models. (Garrison-Omniplan) W82-01062

#### 4C. Effects On Water Of Man's Non-Water Activities

##### SESTON DYNAMICS IN SOUTHERN APPALACHIAN STREAMS: EFFECTS OF CLEAR-CUTTING, Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology.

M. E. Gurtz, J. R. Webster, and J. B. Wallace. Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 624-631, April, 1980. 7 Fig, 4 Tab, 28 Ref.

Descriptors: \*Clear-cutting, \*Logging, \*Seston, \*Forest watersheds, Forest management, Road construction, \*Streams, Suspended sediments, Suspended solids, Sediment transport, Seasonal variation, Storm runoff, Litter, Organic matter, Particle size, Particulate matter, Southern Appalachian streams.

Two second order streams of the southern Appalachian Mountains where heavy logging activities are practiced were studied for suspended particulate matter (seston) from July 1977 to July 1978. In the stream, which drains an undisturbed hardwood forest watershed, seston levels varied with storm flows and were lowest during winter high flows. In this stream, the majority of the organic and inorganic particles were less than 105 microns in diameter. In the stream draining a forest watershed that was clearcut in 1977, increased levels of both organic and inorganic seston were found. Most of the inorganic seston of this stream was made up of particles greater than 235 microns in diameter. These increases were attributed to sediments deposited during the building of logging roads and debris entering the stream during logging activities. The rate of stream recovery will probably

depend on the rate of recovery of the surrounding terrain. (Geiger-FRC) W82-00543

#### THE INFLUENCE OF PLANT COMMUNITIES UPON THE HYDROLOGY OF CATCHMENTS, Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.

For primary bibliographic entry see Field 2D. W82-00931

#### 4D. Watershed Protection

##### SUBMERSIBLE PUMPS HELP QUELL DAMAGE FROM MOUNT ST. HELENS MUDFLOW, Public Works, Vol 112, No 7, p 62-64, July, 1981. 3 Fig.

Descriptors: \*Damage, \*Flooding, \*Volcanoes, \*Submersible pumps, Dredging, \*Mt. St. Helens, \*Mudflows, Disasters, Pumps, Wastewater treatment, Water treatment facilities, \*Castle Rock, Washington, Storm water.

The eruption of Mount St. Helens caused damage to the water supply and wastewater treatment works in the town of Castle Rock, 40 miles from the volcano at the confluence of the Cowlitz and Toutle Rivers. The water supply intake was plugged with ash and debris, as were all sewage and stormwater discharge outfalls. Piping was rearranged to pump the effluent over the levee into the river. Submersible pumps were used to drain the equipment and the land behind the dikes and to pump storm water from a collection point and from a street manhole. Submersible pumps were also used to return water from dredged silt piles to the river. This pump arrangement will help protect the town from serious flooding. (Cassar-FRC) W82-00509

##### LAND FORMING EFFECTS ON DRYLAND SORGHUM PRODUCTION IN THE SOUTHERN GREAT PLAINS, Science and Education Administration, Bushland, TX. Conservation and Production Research Lab. For primary bibliographic entry see Field 3F. W82-00764

##### COORDINATED EFFORT STEMS SEDIMENT AND EROSION,

Anne Arundel County Dept. of Public Works, Annapolis, MD. D. L. Kaiser. Public Works, Vol 112, No 7, p 54-55. July, 1981. 3 Fig.

Descriptors: \*Soil conservation, \*Erosion control, \*Sedimentation, Conservation, \*Anne Arundel County, \*Maryland, Regulations, Legal aspects, Inspection, Chesapeake Bay, Soil stabilization, Permits, Grading.

Soil conservation policies are carried out in Anne Arundel County, Maryland, by the Department of Inspection and Permits, the Soil Conservation District, and the Department of Public Works. Prior to construction, a grading permit must be obtained and all plans approved. A bond or similar security is required for projects disturbing more than 15,000 sq ft of surface area. Inspections are made on site, and over 95% of violations are corrected before any notice needs to be issued. However, the mandated program review of the conservation program in 1974 and 1978 showed some inadequacies. This resulted in guidelines suggesting greater interagency communications, a new procedures manual, stricter enforcement of sediment control, and preconstruction conferences. More recently, stabilization for projects lasting over 45 days has been required. (Cassar-FRC) W82-00766

##### COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,

Idaho Univ., Moscow. Dept. of Agricultural Economics.

D. J. Walker, and J. F. Timmons. Journal of Soil and Water Conservation, Vol 35, No 3, p 177-183, July/August, 1980. 1 Fig, 5 Tab, 20 Ref.

Descriptors: \*Farm management, \*Soil conservation, \*Sedimentation, \*Erosion control, Soil erosion, Nishnabotna River, Iowa, Regulations, Cost-benefit analysis, Agricultural watersheds, Taxes, Land use, Economic aspects, Subsidies.

Soil erosion and sediment discharge reduction programs in agricultural land (study area Nishnabotna River basin, Iowa) were evaluated by linear programming. The most cost-effective policy among the 141 individual solutions was the dual ban on fall plowing and straight row cultivation on slopes. Several strategies were effective in reducing soil losses by 50%—a ban on fall plowing, a soil loss tax of 10-20 cents per ton, and a subsidy for minimum tillage. These three alternatives entailed income penalties of 2-3%. More restrictive policies were capable of reducing soil loss up to 90%—a dual ban on fall plowing and straight row cultivation on slopes, an annual soil loss limit of 5 tons per acre, and a soil loss tax of \$0.50-1.50 per ton. Income penalties on these schemes were less than 14%. (Cassar-FRC) W82-00869

##### ANSWERS: A MODEL FOR WATERSHED PLANNING,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 6A. W82-00898

##### TRACTION FORCE DESIGN OF VEGETATED CHANNELS,

Science and Education Administration, Stillwater, OK. Water Conservation Structures Lab. D. M. Temple.

Transactions of the ASAE, Vol 23, No 4, p 884-890, July/August, 1980. 2 Fig, 4 Tab, 12 Ref.

Descriptors: \*Tractive forces, \*Vegetation effects, \*Channel flow, Mathematical studies, Design criteria, Turbulent flow, Flow resistance, Open channels, \*Erosion control, Mathematical models.

Previous research designed to evaluate the value of a vegetal channel lining as an erosion control measure has established a relatively large data base for use in the development of semi-empirical design procedures. This report updates these design procedures by presenting a method for the application of tractive force principles to the design of vegetated channels. The allowable velocity approach currently used is related not only to soil properties, but also to the vegetal and geometric properties of the channel, requiring tabulation of each possible combination of channel slope, soil, and vegetal cover through separate consideration of the properties of soil and of vegetation. The proposed tractive force design procedure substantially simplified the investigation and tabulation of critical or allowable conditions by permitting separate consideration of the properties of soil and those of the vegetation. The protective value of vegetal channel lining is considered to be derived from two related interactions of the vegetation with the flow field: the generation of turbulent eddies at a significant distance from the soil boundary, creating an increase in flow resistance, and a change in the structure of the turbulent eddies in immediate proximity to the boundary. Two indices believed to relate directly to these interactions are used to classify the vegetation. Guidelines for the selection of these indices according to type and quality of cover are presented. Existing flow resistance curves are put into equational form as a single curve family. The design procedure is directly adaptable to programmed calculation, allowing the incorporation of optimization routines at little additional expense. (Carroll-FRC) W82-00901

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 4D—Watershed Protection

#### 5. WATER QUALITY MANAGEMENT AND PROTECTION

##### 5A. Identification Of Pollutants

**GAS CHROMATOGRAPHIC DETERMINATION OF TRIALKYL/ARYL PHOSPHATES IN DRINKING WATER, FOLLOWING ISOLATION USING MACRORETICULAR RESIN,** Health and Welfare Canada, Ottawa (Ontario). Monitoring and Criteria Div.

G. L. LeBel, D. T. Williams, and F. M. Benoit. Journal of the Association of Official Analytical Chemists, Vol 64, No 4, p 991-998, July, 1981. 4 Fig, 5 Tab, 12 Ref.

Descriptors: \*Ion exchange, \*Organophosphorus compounds, \*Water analysis, Phosphates, Pesticides, Drinking water, Gas chromatography, Phosphorus compounds, \*Pollutant identification.

An XAD-2 screening method developed for organophosphorus pesticides was applied to the determination of trialkyl and triaryl phosphates in drinking water at the ng per liter level. Recovery studies at levels of 1, 10, and 100 ng per liter were carried out by fortification onto XAD-2 resin and by direct on-stream fortification of drinking water. Recoveries for several phosphates using direct fortification were as follows: trialkyl, 19.9-28.9%; triethyl, 88.2-101.2%; tris(2-chloroethyl), 82.9-95.5%; tri(2-ethylhexyl), 61.7-78.8%; tributoxyethyl, 104.5-125.6%; triphenyl, 95.0-107.4%; and tricresyl, 95.0-98.1%. Recoveries by continuous fortification were on the same order, with some exceptions. Drinking water samples from 6 Ontario water treatment plants contained several trialkyl and triaryl phosphates at 0.2 to 75 mg per liter levels, uncorrected for incomplete recoveries. (Cassar-FRC) W82-00502

**THIN LAYER CHROMATOGRAPHIC AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF METHYL MERCURY,** California Univ., Los Angeles. School of Public Health.

L. W. Margler, and R. A. Mah. Journal of the Association of Official Analytical Chemists, Vol 64, No 4, p 1017-1020, July, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: \*Methylmercury, Mercury compounds, \*Pollutant identification, Thin layer chromatography, Atomic absorption spectrophotometry, Sludge, Fish.

Methyl mercury was determined by a combination of thin layer chromatography and atomic absorption spectrophotometry at 253.7 nm. The samples were first distilled with hydrochloric acid and copper sulfate and extracted twice with dithizone-chloroform, followed by chloroform. Dehydration and concentration preceded the chromatography procedure. Samples of tuna, trout, and anaerobically digested sewage sludge were analyzed; methyl mercury contents were 0.056 micrograms per g, 5.26 micrograms per g, and 0.012 micrograms per ml, respectively. Spiking showed that 90% of the methyl mercury was recovered from tuna and 73% from sewage sludge. The method was sensitive to 0.7 ng in the total Hg determination and 0.009 micrograms Hg per g in 100 g samples. (Cassar-FRC) W82-00503

**ENVIRONMENTAL VIROLOGY AND ITS PROBLEMS,** Severn-Trent Water Authority (England).

R. Morris, and W. M. Waite. Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 232-244, May, 1981. 9 Ref.

Descriptors: \*Viruses, \*Water supply, \*Public health, Culturing techniques, Potable water,

Drinking water, Pollutant identification, Enteroviruses, Diseases, Microbiological studies, Water treatment, Severn-Trent Water Authority, \*Great Britain.

Virus assays of waters in the Severn-Trent Water Authority jurisdiction showed that 135 (49%) of 276 surface water samples were positive, the highest level being detected being 337 pfu per liter from the River Tame. Heavily polluted rivers were 88% positive, and stored river water samples were 21% positive. Virus was present in 55% of 132 wastewater effluent samples: the highest recovery value was 5800 pfu per liter. A monkey kidney cell line, designated BGM, was the most suitable cell line tested for virus detection. The suspended cell technique gave higher recoveries than tube culture or the monolayer technique. No direct correlation was found between numbers of viruses in water and any of the bacterial indicator organisms or coliphages. Although there have been no reports of viral infections transmitted through public water supplies in the United Kingdom for many years, the Virology Unit has been established at the water authority to monitor drinking water, abstracted surface waters, and waste water effluents, and to develop more efficient and sensitive techniques for isolating and enumerating viruses. This paper includes background information on the history, character, growth, recovery and identification techniques, classification, diseases, vaccines, and survival in the water system. (Cassar-FRC) W82-00516

#### R FACTORS IN COLIFORM-FECAL COLIFORM SEWAGE FLORA OF THE PRAIRIES AND NORTHWEST TERRITORIES OF CANADA,

Environmental Protection Service, Edmonton (Alberta). Microbiology Lab.

J. B. Bell, W. R. Macrae, and G. E. Elliott. Applied and Environmental Microbiology, Vol 42, No 2, p 204-210, August, 1981. 6 Tab, 23 Ref.

Descriptors: \*Coliforms, \*Drugs, \*Sewage bacteria, Bacteria, Escherichia coli, Public health, Canada, Raw water, Treated water.

The comparative antibiotic resistance and R factors were assessed in the coliform and fecal coliform populations found in raw and treated sewage. Results showed that 8.91% of the total coliform and 10.80% of the fecal coliform populations carried R factors. The following numbers of combinations of R determinants were found: 39 in Escherichia coli, 6 in Citrobacter, 20 in Enterobacter, 10 in Klebsiella, and 11 in Aeromonas. Seven was the maximum number of R determinants transferable simultaneously, and organisms with R factors containing determinants for chloramphenicol usually contained determinants for ampicillin. From 2 to 4% of the coliforms and fecal coliforms were resistant to chloramphenicol, and from 17 to 30% of the populations were resistant to three or more antibiotics. Final effluent discharges to the environment contained R factor carrying coliform populations of 3.1 times 10 to the 4th power/100 ml and fecal populations of 5.8 times 10 to the 2nd power/100 ml. The maximum removal of R positive bacteria from sewage before its discharge into the environment is desirable, as this may be a factor in the reduced effectiveness of antibiotics. (Small-FRC) W82-00508

#### MONITORING TRACE AMOUNTS OF CADMIUM IN NATURAL WATERS,

Brandon Univ. (Manitoba). Dept. of Chemistry. K. Srikameswaran, H. D. Gesser, and M. Venkateswaran.

Journal of Environmental Science and Health, Part A, Vol 15, No 4, p 323-337, 1980. 2 Fig, 4 Tab, 5 Ref.

Descriptors: \*Cadmium, \*Trace metals, Natural waters, Water analysis, \*Pollutant identification, Chelating agents, Heavy metals, Monitoring.

Cadmium may be determined semiquantitatively in trace amounts in water by using 1-(2-pyridylazo-2-naphthol loaded polyester foams. This chemical is

a good complexing agent in the pH 7-8 range, forming a visible orange complex with Cd. The apparatus is operated by squeezing a piece of prepared foam with a piston in a tank of water. Cd concentrations of 3.7, 7.9, 18.6 and 55.9 micrograms per liter were used to determine the amount of Cd extracted by the chemically treated foams in a given number of squeezes (250-1500). Results varied from 5 micrograms Cd from water at 3.7 micrograms per liter concentration and 250 squeezes to 200 micrograms Cd from water at 55.9 micrograms per liter concentration and 1500 squeezes. A plot of Cd extracted per squeeze vs. number of squeezes produced a straight line for each concentration tested. The concentration of Cd in unknown waters may be estimated from a graph plotting Cd concentration against micrograms Cd extracted per squeeze. Other heavy metal ions (Zn, Pb, Cu, and Fe at 100 microgram per liter levels) had no significant effect on the results. (Cassar-FRC)

W82-00516

#### INDUSTRIAL EFFLUENT MONITORING INCORPORATING A RECENT AUTOMATED FISH BIOMONITORING SYSTEM,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.

D. Gruber, and J. Cairns, Jr. Water, Air, and Soil Pollution, Vol 15, No 4, p 471-481, May, 1981. 4 Fig, 38 Ref.

Descriptors: \*Bioindicators, \*Effluents, \*Industrial wastes, \*Pollutant identification, Fish, Fishkill, Water quality control, Monitoring, \*Munitions wastes, Respiration, Water pollution effects, Toxicity, Ammunition plant, Radford, Virginia.

A series of experiments is described which implies that the present concept of automated and continuous biological monitoring is capable of detecting an industrial spill from an ammunition manufacturing plant. The sampling facility is located on site at a US Army Ammunition Plant in Radford, Virginia. Bluegill sunfish, Lepomis macrochirus Raf., served as sensors. Each fish is monitored within individual 6 liter monitor tanks. Twenty-four similar monitor tanks are housed within a compartmentalized module. A minicomputer system converts analog signals into digital information and uses a modified peak-picking program to quantify the frequency of ventilation for each fish over time. Chemical and physical parameters of the effluent are also continuously monitored and interfaced with the computer system. The alarm system consists of a display panel with lights and a bell system within the computer's keyboard. In a 4 hr static bioassay test, the concentration of roll powder effluent which killed half the fish was 25%. However, during a subsequent experiment, all fish survived in 100% effluent. All exposed animals significantly altered their ventilatory behavior within 30 minutes after the initial introduction of the effluent. All which survived had ventilatory rates return to normal within several hours after the effluent exposure ceased. Nitroglycerin was detected at 1.2 ppm in monitor tanks in a water sample taken during a specific time period. Concentrations of DEP and lead were also determined. (Baker-FRC) W82-00530

#### A STUDY OF SAMPLES OF WELL WATER COLLECTED FROM SELECTED AREAS IN CALIFORNIA TO DETERMINE THE PRESENCE OF DBCP AND CERTAIN OTHER PESTICIDE RESIDUES,

California Dept. of Food and Agriculture, Sacramento.

S. A. Peoples, K. T. Maddy, W. Cusick, T. Jackson, and C. Cooper. Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 611-618, 1980. 3 Tab.

Descriptors: \*Agriculture, \*Agricultural chemicals, \*Organic compounds, \*Pesticide residues, \*Water sampling, \*Irrigation, Carcinogens, Wells, \*Well water, Water pollution, Toxicity, Chemical analysis, Crop production, Well data, Soil contamination, Soil analysis.

A survey of possible soil and well-water contamination with DBCP and other pesticide residues

## Identification Of Pollutants—Group 5A

was conducted in selected California counties in 1979. Liquid 1,2-dibromo-3-chloropropane was used as a soil nematicide in California until 1977, when it was banned as a potential carcinogen. In Yolo County all well-water samples were negative. In Ventura and Riverside County wells, samples were also negative. Samples from the east of San Joaquin Valley exhibited contamination in 50% of the wells, primarily those less than 100 feet deep. The route by which DBCP contaminates water supplies is not known. (Titus-FRC)  
W82-00532

**DETERMINATION OF TERBUTRYN AND ITS DEGRADATION PRODUCTS IN WATER, SEDIMENTS, AQUATIC PLANTS, AND FISH,**  
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

D. C. G. Muir.  
Journal of Agricultural and Food Chemistry, Vol 28, No. 4, p 714-719, July/August, 1980. 4 Fig. 4 Tab, 18 Ref.

Descriptors: \*Chemical analysis, \*Water, \*Terbutryn, Chromatography, Agricultural chemicals, \*Herbicides, Ponds, Aquatic plants, Degradation, Farm ponds.

A method for the determination of terbutryn and several of its degradation products, N-deethylated terbutryn (DET), hydroxyterbutryn (HT), N-deethylated hydroxyterbutryn (DEHT), 2-(tert-butylamino)-4-(ethylamino)-s-triazine (EBT), and 2-(tert-butylamino)-4-amino-s-triazine (ABT), is reported. Water samples were extracted with dichloromethane. Sediment, aquatic plant, and fish tissue samples were extracted with aqueous acetonitrile. The hydroxytriazines were isolated by chromatography on a cation-exchange resin and cleanup on alumina and by high-pressure liquid chromatography. Recoveries of terbutryn, DET, HT, DEHT, ABT, and EBT from water (0.5 - 50 micrograms/liter) ranged from 76 to 120%. Terbutryn and DET recoveries from sediment, plants, and fish tissues (0.05 - 0.9 micrograms/gram) ranged from 74 to 106%. HT and DEHT recoveries from sediment, plant material, and fish tissue (0.1 to 1.23 micrograms/gram) ranged from 62 to 124%. (Baker-FRC)  
W82-00567

**SEARCH FOR LINURON RESIDUES IN TRIBUTARIES OF THE CHESAPEAKE BAY,**  
Du Pont de Nemours (E. I.) and Co., Wilmington, DE. Dept. of Biochemicals.

E. W. Zahnow, and J. D. Riggeman.  
Journal of Agricultural and Food Chemistry, Vol 28, No. 5, p 974-978, September/October, 1980. 6 Fig, 4 Tab, 14 Ref.

Descriptors: \*Agricultural chemicals, \*Aquatic plants, Bays, \*Herbicides, \*Chesapeake Bay, Tributaries, \*Linuron, Leaching.

The possible transfer of linuron from farm fields into the Chesapeake Bay was examined using extraction with acetonitrile followed by liquid chromatography. In the sampling area the principal usage of linuron is on soybeans at 0.55 kg/ha. Treatment is made between mid-May and early July. The first sampling followed the first major rain at the end of the treatment season. The second sample was taken 2 months later. Mud, soil and water samples were taken. The analysis of mud and water samples taken during the two successive summers showed no evidence of linuron accumulation. Samples from drainage basins receiving up to 45,000 kg of linuron annually showed no linuron residue, i.e., less than 10 ppbw in the mud and less than 0.2 ppb, w/w in the water. On this basis it was concluded that linuron usage on fields bordering Chesapeake Bay waters and its tributaries is not a contributing factor to the recent declines in the abundance of aquatic plants in the area. (Baker-FRC)  
W82-00569

**EVALUATION OF VARIOUS SOIL WATER SAMPLERS FOR VIROLOGICAL SAMPLING,**

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.  
D.-S. Wang, J. C. Lance, and C. P. Gerba.  
Applied and Environmental Microbiology, Vol 39, No 3, p 662-664, March, 1980. 2 Fig, 1 Tab, 12 Ref.

Descriptors: \*Sampling, \*Viruses, Water quality, Drinking water, Wastewater, Effluent, \*Soil water, Water analysis.

Various types of ceramic soil water samplers were evaluated for virus sampling. Both tap water and sewage effluent were used in the study. Secondary sewage was collected from the effluent of an activated sludge treatment plant before chlorination. The tap water was dechlorinated with sodium thiosulfate before use. Poliovirus 1 (strain LSc), echovirus 1 (strain V239), bacteriophage T2, and bacteriophage MS-2 were added to water samples for the experiments. Before sampling, 500 ml of water was seeded with virus to obtain a concentration of 100,000-1,000,000 plaque-forming units per ml. The percentage recoveries of viruses in water samples after passage through the three samplers was determined. To test the possibility that particulate matter present in the water sample could influence the passage of virus through the samplers, the recovery of virus from both unfiltered and filtered water samples was compared. In general, no significant difference in virus recovery was observed between unfiltered and filtered samples. Soil water samples obtained from both the ceramic cup soil water sampler and the porous ceramic tube exhibited low recoveries of poliovirus and bacteriophage T2. Recoveries of MS-2 and echovirus 1 were substantially higher. The ceramic sampler constructed in the laboratory performing the investigation was consistently superior to the two commercially available soil water samplers tested. (Baker-FRC)  
W82-00572

**SIMULTANEOUS CONCENTRATION OF SALMONELLA AND ENTEROVIRUS FROM SURFACE WATER BY USING MICRO-FIBER GLASS FILTERS,**

Nancy-1 Univ. (France). Lab. d'Hygiène et de Recherche de la Santé Publique.  
D. Rolland, and J. C. Block.  
Applied and Environmental Microbiology, Vol 39, No 3, p 659-661, March, 1980. 2 Tab, 6 Ref.

Descriptors: \*Bacteria, \*Surface water, \*Salmonella, \*Enteroviruses, Filters, Viruses, Monitoring, Recreation facilities, Water quality, Bacterial analysis.

Surface waters were sampled at weekly intervals in January 1979 from the Meurthe River, 8 km south from the city of Nancy, France. Salmonella testing was conducted using a micro-fiber glass filter of 8 micrometers porosity, at pH 3.5. Simultaneous concentrations of Salmonella and enterovirus were determined. Quantitative analysis indicated that Salmonella and viruses are effectively retained or adsorbed or both at pH 3.5 on micro-fiber glass filters. The viral concentrations ranged from 0 to 2.3 MPN/100 ml and the Salmonella concentrations ranged from 1 to 80 bacteria/liter. For Salmonella, as for viruses, a concentration step was required. The water tested was of poor quality due to the presence of a wastewater treatment plant output of the city located 8 km upstream. It was concluded that adsorption at pH 3.5 to microfiber glass filters offers a rapid, effective, quantitative, and relatively inexpensive method for simultaneous concentration of Salmonella and enterovirus. Recreational water quality can then be monitored for two parameters from a single concentration. (Baker-FRC)  
W82-00573

**RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS, BACTERIAL INDICATORS, AND THE OCCURRENCE OF ENTERIC VIRUSES IN ESTUARINE SEDIMENTS,**  
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.

R. L. LaBelle, C. P. Gerba, S. M. Goyal, J. L. Melnick, and I. Cech.  
Applied and Environmental Microbiology, Vol 39, No 3, p 588-596, March, 1980. 3 Fig, 3 Tab, 41 Ref.

Descriptors: \*Estuarine environment, \*Viruses, Bacteria, \*Sediments, Enteric bacteria, Enteroviruses, Indicators, Bioindicators, Recreation, Recreation facilities, Public health, Epidemiology, Shellfish farming.

The occurrence of enteric viruses in estuarine sediments was examined in efforts to find a possible relationship between the presence of viruses in seawater or sediment or both and various biological and physiochemical characteristics of the environment. Sediment was found to contain greater numbers of viruses than overlying seawater on a volume basis. Several types of enteroviruses were isolated, including coxsackievirus types A16, B1, and B3, echovirus type 1, and poliovirus type 2. On several occasions, viruses were isolated from sediments when overlying waters met bacteriological water quality standards for recreational use. Only one significant association was noted in the statistical analysis of a possible relationship between viruses in seawater or in sediment and other variables. This association indicated that the number of viruses in sediment was positively correlated with the number of fecal coliforms in the sediment. No other statistically significant associations were found. Bacterial indicators and viruses in the overlying waters did not appear to be correlated. The evaluation of the presence of bacteria and viruses in sediment may give additional insight into long-term water quality conditions. It is noted that indicator bacteria in water are not reflective of the concentration of enteric viruses in marine waters. (Baker-FRC)  
W82-00574

**EFFECTS OF WASTEWATER SLUDGE AND ITS DETERGENTS ON THE STABILITY OF ROTAVIRUS,**

Sandin Labs., Albuquerque, NM.  
R. L. Ward, and C. S. Ashley.  
Applied and Environmental Microbiology, Vol 39, No 6, p 1154-1158, June, 1980. 3 Fig, 4 Tab, 12 Ref.

Descriptors: \*Sludge, \*Viruses, \*Detergents, Growth, Rotavirus, Wastewater, Reovirus.

A series of inactivation experiments in wastewater sludge were performed with SA-11, a rotavirus strain isolated from a rhesus monkey. Wastewater sludge reduced the heat needed to inactivate rotavirus SA-11, and ionic detergents were identified as the sludge components which were responsible for this effect. This is similar to an effect that had been found earlier with reovirus. The quantitative effects of individual ionic detergents on rotavirus and reovirus were very different, and rotavirus was extremely sensitive to several of the detergents. However, neither virus was destabilized by nonionic detergents. On the contrary, rotavirus was stabilized by a nonionic detergent against the potent destabilizing effects of the ionic detergent sodium dodecyl sulfate. The destabilizing effects of both cationic and anionic detergents on rotavirus were greatly altered by changes in the pH of the medium. Although there may be a number of compounds in sludge that can stabilize rotavirus, nonionic detergents, which are known ingredients of sewage, were shown here to have this stabilizing effect. It is possible that removal of nonionic detergents from sludge caused the destabilizing effects of ionic detergents to be better expressed after their separation from other sludge components. (Baker-FRC)  
W82-00576

**GROWTH OF AEROMONAS HYDROPHILA AT LOW CONCENTRATIONS OF SUBSTRATES ADDED TO TAP WATER,**  
Netherlands Waterworks, Rijswijk. Testing and Research Inst.

D. Van der Kooij, A. Visser, and W. A. M. Huijnen.  
Applied and Environmental Microbiology, Vol 39, No 6, p 1198-1204, June, 1980. 3 Fig, 4 Tab, 29 Ref.

Descriptors: \*Drinking water, \*Bacteria, Growth, Water pollution, \*Aeromonas, Microorganisms, Bioassay, Water treatment, Water quality, Substrates, Biodegradation.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

The growth of *Aeromonas hydrophila* at low substrate concentrations was investigated as part of an investigation on the behavior of different types of bacteria in tap water. Batch experiments were conducted using tap water supplied with low concentrations of substrates. Growth was assessed by colony count determinations. The isolate only multiplied in the used tap water after the addition of a small amount of an assimilable carbon compound. d-Glucose especially caused growth of the organism even at initial concentrations below 10 micrograms C per liter. At initial glucose concentrations below the substrate concentration value (12 micrograms C per liter), generation times and yield were nonlinear with 1/initial glucose concentrations and initial glucose concentrations respectively. The maintenance coefficient  $m$  was calculated from these observations. At initial concentrations below the substrate concentration value of starch, no growth was noted, but complete use of starch occurred in these situations after the addition of 10 micrograms of glucose-C per liter. The results of this study demonstrated that information of ecological significance may be obtained by very simple batch experiments. Moreover, the isolate studied may be used in growth experiments to assess the maximum concentration of glucose present in water, particularly tap water, initially or after various treatment stages. (Baker-FRC)

W82-00578

**ISOLATION AND IDENTIFICATION OF PATHOGENIC MICROORGANISMS AT WASTEWATER-IRRIGATED FIELDS: RATIOS IN AIR AND WASTEWATER,**  
Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.  
B. Teitsch, S. Kedmi, L. Bonnet, Y. Borenzstajn-Rotem, and E. Katzenelson.

Applied and Environmental Microbiology, Vol 39, No 6, p 1183-1190, June, 1980. 1 Fig, 8 Tab, 31 Ref.

Descriptors: \*Wastewater irrigation, \*Pathogens, Microorganisms, *Salmonella*, Enteroviruses, Bacteria, Viruses, Coliforms, Poliovirus, Spray irrigation, Sprinkler irrigation.

The occurrence of *Salmonella* bacteria and animal enteroviruses in aerosol emissions from wastewater irrigation sites was determined by direct assay. An evaluation was made of the suitability of coliforms as indicators of airborne contaminations. Throughout this study different types of sprinklers were used, and consequently different discharge rates, particle numbers, and aerosol volumes were generated in the experimental fields. The frequency of positive *Salmonella* samples was 78% in the wastewater and 18% in the airborne emissions. For enteroviruses, the frequency of positive samples was 71% in the wastewater and 44% in aerosol emissions, indicating higher frequency of enteroviruses in aerosol emissions in comparison to *Salmonella*. The results indicate that enteroviruses and *Salmonella* bacteria survive in the air better than coliform bacteria. In addition it appears that the enteroviruses are more hardy than *Salmonella* in wastewater aerosols. Although coliforms were present in all air samples, their use as indicators of the microbial contamination of air may result in an inaccurate assessment of the true presence or survival of pathogens. (Baker-FRC)

W82-00579

**DESTRUCTION BY ANAEROBIC MESOPHILIC AND THERMOPHILIC DIGESTION OF VIRUSES AND INDICATOR BACTERIA IN-DIGENOUS TO DOMESTIC SLUDGES,**  
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.

G. Berg, and D. Berman.

Applied and Environmental Microbiology, Vol 39, No 2, p 361-368, February, 1980. 3 Fig, 4 Tab, 9 Ref.

Descriptors: \*Bacteria, \*Sludges, \*Bioindicators, Indicators, Temperature effects, Digestion, \*Viruses, Water treatment facilities, Wastewater treatment.

The usefulness of fecal coliforms, total coliforms, and fecal streptococci as indicators of viruses in

raw and digested sludges is demonstrated. The extent to which indicator bacteria and some viruses are destroyed by anaerobic mesophilic and thermophilic digestion of domestic wastewater sludges as these sludge stabilization processes are currently practiced is also examined. Large variations were found in the numbers of viruses occurring over narrow ranges of numbers of fecal coliforms, total coliforms, and fecal streptococci in raw sludges and in mesophilically and thermophilically digested anaerobic sludges. This finding suggests that the bacteria were poor quantitative reflectors of the numbers of the viruses detected. All three indicator bacteria were destroyed more rapidly than were the viruses by mesophilic and thermophilic digestion of the anaerobic sludges. The relative rates for the destruction of viruses, fecal coliforms, and fecal streptococci in the digested sludges were consistent over the 17 month study. Fecal coliforms were 7 to 8 times more sensitive than the viruses to mesophilic digestion and 9 to 10 times more sensitive to thermophilic digestion. Even more sensitivity was noted among the total coliforms. The rates at which fecal streptococci were destroyed by mesophilic and thermophilic digestion of anaerobic sludges approached those at which the viruses were destroyed by those processes. This suggests that rates of fecal streptococci destruction may be used as indicators for the rates at which viruses in sludges are destroyed by these processes. (Baker-FRC)

W82-00580

**MONITORING RIVER PERiphyton WITH ARTIFICIAL BENTHIC SUBSTRATES,**  
Bowling Green State Univ., OH. Dept. of Biological Sciences.

R. L. Lowe, and W. F. Gale.

Hydrobiologia, Vol 69, No 3, p 235-244, March, 1980. 2 Fig, 4 Tab, 17 Ref.

Descriptors: \*Periphyton, \*Substrates, \*Algal growth, Algae, Rivers, \*Benthic environment, \*River beds, Monitoring, Susquehanna River, Species composition, Water quality analysis, Pennsylvania.

Frosted acrylic was the most satisfactory artificial substrate for studying periphyton colonization on a river bottom. Other substrates tested at the bottom of the Susquehanna River, near Falls, Pennsylvania, were smooth glass, frosted glass, Vermont slate, and sandy slate (flagstone). Natural river stones were collected for comparison. The most abundant algae on the substrates were diatoms, with *Nitzschia* and *nivalis* most often dominating. The genera *Cocconeis*, *Synedra*, *Asterionella*, *Gomphonema*, *Meridion*, *Cymbella*, *Fragilaria*, *Stephanodiscus*, *Cyclotella*, and *Melosira* were also well represented. A 1-month exposure time showed very little colonization in December through April, but from May through November, communities from 1,000 to 10,000 units per sq mm were found. The densest communities were accumulated in October. The long-term, or cumulative, substrates had the densest periphyton communities in winter, with decreasing densities in June-October. The greatest periphyton density was found on a river stone in February (21,850 units per sq mm). Any of the substrates would be satisfactory to determine the dominant genera in the periphyton. The number of genera on artificial substrates tended to be higher than the numbers on river stones. It is suggested that 1-month colonization periods are not enough; substrates should be collected after several month's submergence. (Cassar-FRC)

W82-00581

**CATION CHROMATOGRAPHY WITH A CONDUCTIVITY DETECTOR,**  
Ames Lab, IA.

J. S. Fritz, D. T. Gjerde, and R. M. Becker.

Analytical Chemistry, Vol 52, No 9, p 1519-1522, August, 1980. 6 Fig, 5 Ref.

Descriptors: \*Chromatography, \*Cations, \*Cation exchange, \*Conductivity, Drinking water, Water analysis, Hardness, Ammonium, Calcium, Magnesium.

A system for cation analysis which successfully separates inorganic and amine cations was developed. Using this cation chromatography system metal and ammonium cations are separated on a cation-exchange column of low capacity and are detected with a conductivity detector. There is no need for a suppressor column. Mixtures of alkali metal and ammonium ions are separated using a nitric acid eluent, while an eluent containing an ethylene-ammonium salt is used to separate magnesium, calcium, strontium, and barium ions. The procedure requires 5 to 10 min. In experiments with drinking water, the method was used to determine alkali metal ions, ammonium, magnesium(II), and calcium(II). This procedure is similar in speed and convenience to atomic spectrometry methods, and has the advantage that ammonium ions can be determined simultaneously. Cation chromatography is a promising method for water hardness analysis, as it gives both magnesium and calcium hardness. (Small-FRC)

W82-00582

**ENUMERATION OF BACTERIOPHAGES AND HOST BACTERIA IN SEWAGE AND THE ACTIVATED-SLUDGE TREATMENT PROCESS,**  
Clemson Univ., SC. Dept. of Microbiology.

D. L. Ewert, and M. J. B. Paynter.

Applied and Environmental Microbiology, Vol 39, No 3, p 576-583, March, 1980. 6 Tab, 26 Ref.

Descriptors: \*Bacteria, \*Wastewater, Bacteriophage, Viruses, \*Wastewater treatment, Water treatment facilities, Effluents, Influent water, Activated sludge, Sludge.

Enumeration was made of bacteriophage populations in an activated-sludge sewage treatment plant. A newly developed assay for quantitation of total phases, employing direct electron microscopic counts, was used in conjunction with the plaque assay. The total concentration of phages was significantly higher in reactor mixed liquor and effluent than in influent sewage, indicating a net production of phages within the reactor. Maximum total phage concentrations in the fluid phase of sewage, activated-sludge mixed liquor, and reactor effluent, were 2.2 times 10 to the seventh power, 9.5 times 10 to the seventh power, and 8.4 times 10 to the seventh power, respectively. In general, specific plaque titers were lower in mixed liquor than in sewage, indicating that these hosts were not responsible for the net production of phages in the reactor. This study emphasizes the limitations of the plaque assay for ecological studies of phages, and suggests that bacteria responsible for phage production in activated-sludge mixed liquor either mirror components of the heterotrophic population, floc-producing strains, or members of other physiological groups. (Baker-FRC)

W82-00584

**METAL SPECIATION. EFFECTS ON AQUATIC TOXICITY,**  
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.

H. E. Allen, R. H. Hall, and T. D. Brisbin.

Environmental Science and Technology, Vol 14, No 4, p 441-443, April, 1980. 2 Fig, 1 Tab, 24 Ref.

Descriptors: \*Aquatic life, \*Metals, Metal complexes, \*Chelating agents, Toxicity, Metal-finishing wastes, Industrial wastes, Heavy metals, Algae, \*Algal growth, Natural waters.

The effect of chelation in aquatic environments has been investigated. Experiments were conducted to demonstrate that algal toxicity is related to the free metal ion and not to the total soluble metal concentration. A series of algal bioassays was conducted in which zinc and various chelators were added. To relate algal growth to the chemical forms of zinc present, stability constants for the reaction of each of the chelators with hydrogen, calcium, and magnesium ions, as well as with zinc ions, were required. For all cultures in which there was an increased number of algae after 5 days, the logarithm of the number of cells was plotted vs. the calculated concentration of free zinc. In addition, data were included for a series of controls in which no additional chelator was added to the media, but

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

in which the concentration of added zinc was varied. The results demonstrated that the toxicity of trace metals to algae is directly dependent on the concentration of free metal ion rather than the total metal concentration. This method of predicting biological toxicity could be extended to natural waters provided adequate information on organism response to equilibrium relations for the metal are available. An understanding of the relationship of an organism's response to the specific chemical form of a toxicant in the environment rather than to its total concentration is an important consideration in the development of water quality criteria. (Baker-FRC)

W82-00610

#### ADSORPTION AS A CONTROL OF METAL CONCENTRATIONS IN SEDIMENT EXTRACTS, Australian Atomic Energy Commission Research Establishment, Lucas Heights.

P. S. Rendell, G. E. Batley, and A. J. Cameron. Environmental Science and Technology, Vol 14, No 3, p 314-318, March, 1980. 3 Fig, 5 Tab, 16 Ref.

Descriptors: \*Metals, \*Water analysis, Chemical analysis, \*Sediments, Copper, Lead, Cadmium, Heavy metals, \*Adsorption, Extraction, Sediment concentration.

Extractants spiked with copper, lead, or cadmium were shaken overnight with river sediment, and the solution metal concentrations were compared before and after the overnight extraction. To give an indication of the range of extraction reagents that might be affected, adsorption was investigated as a function of pH and in the presence of reducing agents, strong and weak complexing agents, a weak acid, an oxidizing agent, and a cation exchanger. The adsorption of added metal in these experiments was assumed to constitute evidence for the readorption of metal released during sediment extractions. Significant adsorption of added metal occurred during overnight extraction with dilute hydrochloric acid with a pH of more than 1.5, 0.1 M hydroxylamine hydrochloride with a pH of 2, 0.1 M sodium citrate with a pH of 4.6, 1 M ammonium acetate, 10% sodium citrate-1% sodium dithionite, and 25% acetic acid. Adsorption also occurred during a hydrogen peroxide digestion procedure. The inability of reagents to prevent losses of soluble metal in these experiments strongly suggests that proportion of the metal actually released from a sediment sample during an extraction will be readorsbed. This may lead to serious misinterpretation of extraction data, because the metal concentrations determined in the extract do not represent metal levels in the sediment fractions attacked. (Baker-FRC)

W82-00614

#### AN ENVIRONMENTAL SAFETY ASSESSMENT OF BUTYL BENZYL PHTHALATE, Monsanto Co., St. Louis, MO.

W. E. Gledhill, R. G. Kaley, W. J. Adams, O. Hicks, and P. R. Michael. Environmental Science and Technology, Vol 14, No 3, p 301-305, March, 1980. 4 Tab, 26 Ref.

Descriptors: \*Chemical industry, \*Environmental protection, Phthalates, Safety, Environmental effects, Assessments, Water quality, Algal growth, Toxicity, Fish, \*Butyl benzyl phthalate, Biodegradation.

The environmental safety of butyl benzyl phthalate (BBP) was evaluated through both laboratory and field studies. BBP itself is relatively insoluble in water and tends to partition to soil, sediment, and biota in the aqueous environment. Biodegradation, the rate controlling process for environmental degradation of BBP, is rapid and extensive in natural water and sewage systems. Environmental levels of BBP averaged less than 1 microgram/liter in water and less than 100 ng/g in sediment. BBP is acutely toxic to a variety of algae, invertebrates, and fish in the 0.5 to 5 mg/liter range and chronically toxic to Daphnia and fathead minnows in the 0.1-0.8 mg/liter range. A bioconcentration study indicated that BBP was not an accumulative or persistent chemical in fish. Comparison of mean

environmental water concentrations of BBP to laboratory chronic toxicity values for Daphnia and fathead minnows showed an average safety margin of about three orders of magnitude. This current safety assessment concludes that BBP under present use and disposal patterns does not constitute a hazard to the safety and well being of the aquatic environment. (Baker-FRC)

W82-00615

#### VOLTAMMETRIC CHARACTERIZATION AND CHEMICAL BEHAVIOR OF INORGANIC TIN IN NATURAL WATERS, Istituto di Ricerca sulle Acque, Rome (Italy).

G. Macchi, and M. Pettine. Environmental Science and Technology, Vol 14, No 7, p 815-818, July, 1980. 8 Fig, 28 Ref.

Descriptors: \*Natural waters, \*Tin, Seawater, Chemical analysis, Water analysis, Measuring instruments, \*Volumetric analysis, Comparison studies.

Differential pulse anodic stripping voltammetry was used to test a solution containing 16 ppb of Sn(IV) in 0.04 M sodium nitrate and in artificial seawater as a function of pH. At a pH value below 7, a peak of anodic redissolution due to the oxidation of Sn(0) to Sn(II) became apparent. The peak potential shifted as a function of pH and indicated the formation of Sn(OH)(+) in the stripping process. The height of the peak decreases markedly with time in acid solution near pH 4 to 6. The results suggest that the stable forms of Sn(IV) are a function of pH. The differential pulse anodic stripping voltammetry analysis of surface seawater and samples collected at depth of 100 meters at the mouth of the Tiber River indicate the existence of Sn. The measured Sn peak was stable for at least six months. The findings indicate that soluble tin is present in natural waters in the form of Sn(OH)(3-) when the pH is about 8. At lower values of pH, Sn may polymerize from Sn(OH)2. (Baker-FRC)

W82-00627

#### DETERMINING VOLATILE ORGANICS IN WATER, Monsanto Industrial Chemicals Co., St. Louis, MO.

J. P. Mieure. Environmental Science and Technology, Vol 14, No 8, p 930-935, August, 1980. 4 Fig, 5 Tab, 19 Ref.

Descriptors: \*Pollutant identification, \*Organic compounds, Water analysis, Chemical analysis, Isolation.

Six techniques for low-level, multicomponent analysis of volatile organics in water are described. The key to analytical techniques for volatile organic determinations lies in the isolation step. This step determines the types of compounds to be measured, the expected accuracy and precision, and the potential interferences. Once the isolation and concentration steps have been achieved, the spectroscopic or chromatographic measurement of the analyte is usually straightforward. Static headspace sampling has detection limits ranging from sub- to mid-microgram/liter concentrations, depending on the compound and the detector. Purge and trap sampling has greater sensitivity than static headspace sampling, but foaming may be a problem. Solid sorbents have been shown effective for selected compounds, but the general usage for concentrations less than 50 micrograms/liter needs verification. Liquid/liquid extraction is useful for compounds for which specific detectors are available. Precision is better than with "x" purge and trap technique. Sample cleanup is minimal, so removal of interferences is unlikely. Distillation is effective in concentrating water-soluble volatile organics. Semipermeable membranes are not widely used for isolation of volatiles; however, rapid analyses are possible when they are used as a selective introduction device for a mass spectrometer. (Baker-FRC)

W82-00630

#### ACCURATE AND EFFICIENT ESTIMATION OF BENTHIC POPULATIONS: A COMPARISON

#### SON BETWEEN REMOVAL ESTIMATION AND CONVENTIONAL SAMPLING TECHNIQUES, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.

F. L. Carle, and O. E. Maughan.

Hydrobiologia, Vol 71, No 1/2, p 181-187, May 27, 1980. 2 Fig, 1 Tab, 5 Ref.

Descriptors: \*Sampling, \*Benthos, \*Species diversity, Invertebrates, Biological samples, Water quality, \*Bioindicators, Circular Depletion Sampler, Benthic populations.

The continuing use of benthic communities as indicators of water quality requires use of accurate and efficient quantitative sampling techniques. The removal method using the Circular Depletion Sampler (CDS) was developed to collect consecutive subsamples from the same location, increasing the probability of capture. Average probability of capture, using three subsamples, from 270 CDS samples ranged from 0.19 for Antocha to 0.96 for Chironomidae. These population estimates were higher and less variable than single removal catches, Surber catches, or kick-net catches. Although sampling time was nearly equal for all three methods, the CDS method required less than half the time to separate the benthos from the substrate. Catchability varied with species, person collecting the samples, and sampling conditions. (Cassar-FRC)

W82-00633

#### IDENTIFICATION OF ORGANIC COMPOUNDS, NUS Corp., Pittsburgh, PA., Analytical Services Lab.

G. D. Burns. Industrial Wastes, Vol 26, No 4, p 23-25, July/August, 1980. 6 Fig.

Descriptors: \*Organic compounds, \*Measuring instruments, \*Chemical analysis, Wastewater analysis, Wastewater composition, \*Pollutant identification.

A large increase in the usefulness of gas chromatographic/mass spectrometric analytical methods is forecast as a result of increasing demands for certain standards to be met in wastewater discharging. The basis of the identification of an unknown compound is the retention time, that is, the length of time required for the compound to elute from a specific GC column under controlled conditions of column temperature and carrier gas flow rate. Mass spectrometry offers information concerning a compound's molecular weight and structure which is not available from conventional GC detectors. Computer technology has vastly increased the capabilities of a modern GC/MS system. The cost of a GC/MS with a data system varies from bench top models for about \$60,000 to a complete data system for about \$250,000. (Baker-FRC)

W82-00635

#### EVALUATION OF STANDARD AND MODIFIED M-FC, MACCONKEY, AND TEEPOL MEDIA FOR MEMBRANE FILTRATION COUNTING OF FECAL COLIFORMS IN WATER, National Inst. for Water Research Pretoria (South Africa).

W. O. K. Grabow, C. A. Hilner, and P. Coubrrough. Applied and Environmental Microbiology, Vol 42, No 2, p 192-199, August, 1981. 13 Tab, 31 Ref.

Descriptors: \*Coliforms, \*Culture media, \*Water analysis, Bacteria, Agars, \*Fecal coliform, Microbiological studies, Rivers, Activated sludge, Performance evaluation, Pollutant identification.

Counts obtained by means of different growth media recommended for membrane filtration counting of fecal coliforms were compared and isolates were identified to establish the composition of fecal coliforms in various water environments. Media included M-FC agar, modified M-FC agar which contains no rosolic acid, Tepol media, and MacConkey agar. Comparative tests were per-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

formed on 312 samples including chlorinated effluents. M-FC agar without rosolic acid generally yielded the highest counts, was readily obtainable, was easy to prepare and handle, and yielded clearly recognizable fecal coliform colonies. Fecal coliform tests cannot be used to determine *E. coli* levels because in these tests the incidence of *E. coli* among fecal colonies varies from 51% for river water to 93% for activated sludge effluent. *Klebsiella pneumoniae* averaged 4% for sludge effluent and 32% for river water. The standard membrane filtration procedure using M-FC agar without rosolic acid gave clear advantages. (Small-FRC) W82-00644

#### MODIFICATION OF THE STANDARD MOST-PROBABLE-NUMBER PROCEDURE FOR FECAL COLIFORM BACTERIA IN SEAWATER AND SHELLFISH,

Food and Drug Administration, Davisville, RI. Construction Battalion Center.

F. Dexter.  
Applied and Environmental Microbiology, Vol 42, No 1, p 184-185, July, 1981. 1 Tab, 2 Ref.

Descriptors: \*Coliforms, \*Water analysis, \*Seawater, Bacterial analysis, Bacteria, Brackish water, Saline water, Shellfish.

A total of 572 seawater and shellfish samples were collected and used in a study to determine whether or not presumptive tubes which take 48 hr to become positive need to be transferred to EC medium during the fecal coliform multistage most-probable-number procedure. It appeared that incorrect dilution data would be rare when the 24 hour positive tubes alone were transferred to EC. It is suggested that when the fecal coliform multistage most-probable-number procedure is performed, the presumptive test could be discontinued after 24 hr. An exception could be made for those situations in which either extreme accuracy or a high recovery rate is necessary, for example, in a comparative study of media or techniques or both. (Baker-FRC) W82-00646

#### EFFECT OF OZONATION AND CHLORINATION ON THE MUTAGENIC POTENTIAL OF DRINKING WATER,

Florence Univ. (Italy). Inst. of Pharmacology. P. Dolara, V. Ricci, D. Burrini, and O. Griffini. Bulletin of Environmental Contamination and Toxicology, Vol 27, No 1, p 1-6, 1981. 2 Fig, 12 Ref.

Descriptors: \*Chlorination, \*Ozonation, \*Toxicity, Water treatment, Drinking water, Water quality, Public health, Mutagenic chemicals, \*Florence, Italy.

Water from a treatment plant in Florence, Italy, was tested for mutagenic activity using the Salmonella/microsomes test. The plant treats water from the Arno River with the following treatment scheme: prechlorination, addition of powdered activated carbon, coagulation and flocculation, decanting, rapid sand filtration, ozonation, and final chlorination. Dose response curves, with and without metabolic activation, were obtained by plating different amounts of DMSO concentrates. Untreated water had a negligible mutagenic activity, whereas significant, although low, mutagenic activity was introduced by chlorination. After ozone treatment, the water showed more mutagenic activity but less than after chlorination. Ozone treatment may be an alternative to chlorination for disinfection and odor removal in water treatment. Mutagenic chemicals were produced by chlorination, while ozonation could minimize the exposure to mutagenic chemicals in drinking water. The effect of ozonation on heavily contaminated waters is not known. (Small-FRC) W82-00649

#### NEW WATERBORNE BACTERIOPHAGES ACTIVE ON YERSINIA ENTEROCOLITICA,

Granada Univ. (Spain). Dept. of Microbiology. C. Calvo, J. Brault, J. M. Alonso, and H. H. Mollaret.

Applied and Environmental Microbiology, Vol 42, No 1, p 35-38, July, 1981. 5 Tab, 8 Ref.

Descriptors: \*Bacteriophage, \*Isolation, \*Bacterial analysis, Water analysis, Viruses, Surface water, Enterobacter, Bacteria, Enteric bacteria, \*Granada, Spain.

A phage typing scheme for *Yersinia enterocolitica* (YE) was investigated using bacteriophages isolated from surface waters. Seven bacteriophages active on YE were isolated from surface water samples collected in Granada, Spain. A comparison of the respective host ranges of these new phages and of reference phages used for YE phage typing showed that YE strains belonging to various phage types, grown at either 37 or 23 degrees C, expressed susceptibility to reference sewage water phages, whereas susceptibility to new waterborne phages, as well as to reference phages from lysogenic YE, was only demonstrated in YE strains grown at 23 degrees C. A YE strain isolated by stool culture from a pig was lysogenic for a bacteriophage which behaved like waterborne phages and reference phages from lysogenic YE strains. The possibility that the isolation of waterborne bacteriophages might, in certain circumstances, reflect the presence of lysogenic YE was raised. (Baker-FRC) W82-00662

#### OCCURRENCE OF CYTOPHAGAS IN SEWAGE PLANTS,

Gesellschaft fuer Biotechnologische Forschung, m.b.H., Stockheim (Germany, F.R.). H. Gude.

Applied and Environmental Microbiology, Vol 39, No 4, p 756-763, April, 1980. 3 Fig, 5 Tab, 27 Ref.

Descriptors: \*Bacteria, \*Activated sludge processes, \*Cytophagids, Activated sludge, Microbiological studies, Biological treatment, Wastewater treatment.

In order to better understand biological sewage purification processes, the occurrence of bacteria belonging to the Cytophaga group in activated sludge from a treatment works was investigated. Plate count methods and the KOH-flexirubin test were used to determine Cytophagids. In the inflow sewage water, the percentage of Cytophaga colonies was generally low when compared with values for activated sludge, trickling filters, and effluent samples. Over a period of 16 months, the highest percentages of cytophagids were found in activated sludge and trickling filter samples collected during the winter. Also, cytophagids were found to have high percentages of the bacteria lytic to polymeric substrates such as cellulose, chitin, dextran, pectin, xylan, and gelatin. Polymer breakdown may be the way cytophagids contribute to sewage purification, especially at low temperatures. Isolated strains of Cytophaga had gliding motility, flexirubin pigmentation, and a low quinone plus cytosine base ratio. (Small-FRC) W82-00672

#### ORGANOCHLORINE RESIDUES IN KENYA'S RIFT VALLEY LAKES,

National Wildlife Federation, Washington, DC. J. L. Lincer, D. Zalkind, L. H. Brown, and J. Hopcraft.

Journal of Applied Ecology, Vol 18, No 1, p 157-171, April, 1981. 1 Fig, 6 Tab, 29 Ref.

Descriptors: \*Pesticide residues, \*Aquatic life, \*Lakes, Wildlife, Pollutant identification, Chlorinated hydrocarbons, Fish, Birds, Water birds, Insects, Invertebrates, Vegetation, Algae, Eggs, Africa, Rift Valley, Lake Nakuru, \*Kenya, Fate of pollutants, DDT, DDE.

Organochlorine pesticide residues were determined in aquatic life in four Rift Valley lakes in Kenya-Naivasha, Nakuru, Baringo, and Elmenteita. These lakes are closed basin systems with no external outlet. Pesticides used in the L. Nakuru catchment basin include DDT, dieldrin, toxaphene, dioxathion, and abate (temephos). The only organochlorine detected in samples was DDE, a DDT metabolite. DDE residues in vegetation, insects,

fish, amphibians, mammals, bird eggs, and bird muscle are reported for each lake. Lake Elmenteita is probably the most pesticide-contaminated of the four lakes, but the small sample sizes did not permit a definite conclusion. L. Nakuru had the highest DDE levels, with L. Naivasha and Baringo, lesser levels. Some of the higher mean levels of DDE (in mg per liter oven dry weight) were: ferns in L. Naivasha, 0.107; fish in L. Baringo, 0.43-2.13; insects in L. Baringo, 0.90; and an otter from L. Nakuru, 0.35. Residues in eggs from fish eating birds were as high as 5.75 mg per liter DDE oven dry weight in the African darter from L. Nakuru. The highest residue of DDE in avian muscle tissue was 1.09 mg per liter oven dry weight in maribou stork from L. Nakuru. (Cassar-FRC) W82-00690

#### TOXICS IN MUNICIPAL AND INDUSTRIAL WASTEWATERS,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.

D. F. Bishop.

In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix D, November, 1980. 98 p. 1 Fig, 32 Tab, 29 Ref, 3 Append. International Joint Commission, Windsor, Ontario.

Descriptors: \*Hazardous materials, \*Pollutant identification, Organic compounds, Waste disposal, Waste management, Waste load, Organic loading, \*Industrial wastewater, Technology, Waste characteristics, Pretreatment of water, \*Toxins, \*Municipal wastewater, Great Lakes.

Legislative and court actions are forcing the evolution of systematic toxic management approaches to limit environmental exposure to toxics in both Canada and the United States. This report, as background to a discussion on toxic loading estimates in the Great Lakes, reviews legislative actions in the U.S. and various treatment processes studied in a 25-city survey. Approaches evaluated for the treatment of 129 "primary pollutant" compounds included removal systems, pretreatment, toxics loads, treatability, and removability. Not unexpectedly, there was a wide variation found among industrial plants for compounds identified and concentrations recorded. Similarly, removal of specific compounds varied from zero to almost 100 percent. Of the 87 compounds detected, 24 organics and 13 metals were found in all of the plants. Chlorination for disinfection generally increased the concentrations of certain compounds. The report recommends that the following issues related to municipal and industrial wastes in the Great Lakes area be studied: updating and reliability of the estimated toxics loads, municipal and industrial sources of toxics, monitoring issues, wastewater chlorination, land treatment vs. conventional wastewater treatment, and pre-treatment vs. centralized municipal treatment. (Garrison-Omniplan) W82-00712

#### NEW LIQUID CHROMATOGRAPHIC DETECTION SYSTEM FOR ENVIRONMENTAL POLLUTANTS,

Georgia Univ., Athens.

L. A. Carreira, and L. B. Rogers.

Environmental Protection Agency Report EPA-600/4-80-015, February 1980. 71 p, 30 Fig, 3 Tab, 29 Ref.

Descriptors: \*Water analysis, \*Liquid chromatography, \*Polychlorinated biphenyls, \*Hydrocarbons, Spectrometers, Solvents, Computers, Automation, \*Pollutant identification.

Resonance enhanced coherent anti-Stokes Raman spectrometry (CARS) has been demonstrated as a specific identification system for liquid chromatography. To achieve this, liquid chromatographic preconcentration and separation and computer control of the liquid chromatograph/ultraviolet-visible/CARS were undertaken. Under the optimum resonance condition, spectra were obtained of 1 microliter volumes with detection limits of 1 micromolar or less under favorable conditions. Excellent fluorescence rejection and ultraviolet

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

CARS were also shown. A number of different species (polynuclear aromatic hydrocarbons and polychlorinated biphenyls) were surveyed by liquid chromatography with the selectivity of different stationary phases and special solvent effects examined. Observations useful in relating experimental variables in the preconcentration step to the recovery of given species were made. A system consisting of a liquid chromatograph, a scanning ultraviolet-visible spectrometer and the CARS was automated using a mini-computer. Column selection, flow rate, and solvent composition were monitored and controlled. The ultraviolet-visible spectrometer was used at a fixed wavelength until a species was detected. The flow was stopped, the absorption spectrum was scanned, and flow was resumed. The optimum laser frequencies for resonance CARS were set from the absorption spectrum. The Raman spectra were then scanned under control of the computer with on-line signal averaging and data smoothing. (Author's abstract)  
W82-00740

#### INTERIM METHOD FOR DETERMINING ASBESTOS IN WATER,

Environmental Research Lab., Athens, GA.  
C. H. Anderson, and J. M. Long.  
Environmental Protection Agency Report EPA-600/4-80-005, January 1980. 43 p, 2 Fig, 2 Tab, 13 Ref.

Descriptors: \*Water analysis, \*Microscopic analysis, \*Asbestos, \*Electron microscopy, Drinking water, Filtration, Hazardous materials, Water pollution, Pollutants.

This revised interim method for asbestos in drinking water and water supplies reflects the improvements that have been made in asbestos analytical methodology since the initial procedure was drafted. A variable, known volume of water sample is filtered through a 0.1 micrometer polycarbonate membrane filter and the filter is then carbon coated. A small portion of the filter is placed on an electron microscope grid and the filter material is removed by solution in chloroform. The material remaining on the grid is examined in a transmission electron microscope at 20,000 magnification. Chrysotile asbestos can be differentiated from amphibole by their morphologies and electron diffraction patterns. The number of fibers in a known area examined in the microscope is converted to number of fibers per liter, and the mass per liter can be calculated from the assumed density and volume of the fibers. The method can detect 0.01 million fibers per liter or 0.1 ng/l, under favorable circumstances. (Brambley-SRC)  
W82-00741

#### SAMPLE INTAKE POSITION AND LOADING RATES FROM NONPOINT SOURCE POLLUTION,

National Forest Service, Challis, ID.  
P. E. McGuire, T. C. Daniel, D. Stoffel, and B. Andraski.  
Environmental Management, Vol 4, No 1, p 73-77, January, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: \*Nonpoint pollution sources, \*Runoff, \*Sampling, Water quality, Monitoring, Bed load, Suspended solids, Phosphorus compounds, Nitrogen compounds, Pollutant identification, Water sampling.

Paired water samples were taken simultaneously at two different vertical positions in a flow control structure designed for monitoring nonpoint source pollution. It was determined that easily transported pollutants and those with more potential for immediate impact on water quality should be sampled at the midstage level. If total transport of contaminants from a particular land use is required, then bed load sampling must be used. Suspended solids, total phosphorus, and organic plus exchangeable N were consistently higher when sampled at the floor of the apparatus than those sampled at midstage. Dissolved molybdate reactive phosphorus and ammonium concentrations were not significantly affected by intake position. Concentrations of nitrate-nitrite were much higher when sampled at the midstage level. Levels produced by midstage

sampling, expressed as a percent of bed load (floor) sampling, were as follows: suspended solids, 44; total phosphorus, 39; organic plus exchangeable N, 35; dissolved molybdate reactive phosphorus, 80; ammonium, 71; and nitrate-nitrite, 181. (Cassar-FRC)  
W82-00778

#### SIMULTANEOUS DETERMINATION OF IRON, CADMIUM, ZINC, COPPER, NICKEL, LEAD, AND URANIUM IN SEAWATER BY STABLE ISOTOPE DILUTION SPARK SOURCE MASS SPECTROMETRY,

National Research Council of Canada (Ontario). Div. of Chemistry.  
A. P. Mykytiuk, D. S. Russell, and R. E. Sturgeon. Analytical Chemistry, Vol 52, No 8, p 1281-1283, July, 1980. 2 Tab, 19 Ref.

Descriptors: \*Seawater, \*Trace elements, \*Water analysis, Mass spectrometry, Chemical analysis, Copper, Iron, Zinc, Cadmium, Nickel, Lead, Uranium, Cobalt.

Seawater samples have been analyzed at trace concentration levels by stable isotope dilution spark source mass spectrometry for iron, cadmium, zinc, copper, nickel, lead, uranium, and cobalt. The samples were preconcentrated on the ion exchanger Chelex-100 and the concentrate was evaporated on a graphite or silver electrode. The results are compared with those obtained by graphite furnace atomic absorption spectrometry and inductively coupled plasma emission spectrometry. The technique avoids the use of calibration standards and is capable of producing results in cases where the analyte is only partly recovered. (Baker-FRC)  
W82-00786

#### AQUATIC MOSES AS MONITORS OF HEAVY METAL CONTAMINATION IN THE RIVER ETHEROW, GREAT BRITAIN,

Durham Univ. (England). Dept. of Botany.  
P. J. Say, J. P. C. Harding, and B. A. Whittom. Environmental Pollution, Series B, Vol 2, No 4, p 295-307, 1981. 3 Fig, 9 Tab, 13 Ref.

Descriptors: \*Mosses, \*Bioindicators, \*Zinc, Heavy metals, Metals, Chromium, Aquatic plants, Rivers, Pollutant identification, Sediments, Water analysis, Monitoring, Etherow River, \*Great Britain.

Zinc concentrations in two aquatic mosses, *Fontinalis squamosa* and *Rhynchostegium riparioides*, showed significant positive correlation, suggesting that these species may be useful bioindicators for Zn contamination of river water. Samples of water, sediments, and moss were collected on 5 occasions at 9 sites during 1979 and 1980 in the River Etherow, Great Britain, and analyzed for heavy metals. Levels of metals in sediments and water showed a similar pattern with the exception of proportionately higher levels of Cr in sediments at 3 sites. Zn levels were 0.22 to 14.6 mg per liter in water, 73.7-4960 micrograms per g in sediments, and 64.1-6705 micrograms per g in mosses. Although Cr was not detected in water, it was present in mosses from some sites, indicating previous contamination. Data obtained for *Amblystegium riparium* and *Fontinalis antipyretica* were not sufficient to assess their value as monitors. (Cassar-FRC)  
W82-00787

#### FORMATION OF N-NITROSOETHANOLAMINE FROM DIETHANOLAMINE IN LAKE WATER AND SEWAGE,

Cornell Univ., Ithaca, NY. Dept. of Agronomy. J. R. Yordy, and M. Alexander. Journal of Environmental Quality, Vol 10, No 3, p 266-270, July/September, 1981. 5 Fig, 20 Ref.

Descriptors: \*Wastewater, \*Lakes, \*Nitrosamines, \*Diethanolamine, Carcinogens, Nitrogen compounds, Toxins, Pollutants, Nitrite, Pollutant identification, Chromatography.

Diethanolamine (DEIA) is a compound of potential environmental concern due to its presence in a

number of industrial and consumer products which result in the discharge of large amounts of the unchanged chemical into wastewater and sewage. The N-nitroso derivative of DEIA, N-nitrosodiethanolamine (NDEIA), is proven carcinogen. This study used a thin-layer chromatographic technique with a carbon-14 labeled secondary amine to measure the possible formation of nitrosamines in samples of natural waters and sewage. The lower limit of sensitivity was 1 nanogram of nitrosamine per milliliter. The formation of NDEIA from DEIA in both lake waters and sewage was demonstrated. A combination of gas chromatography and mass spectrometry was used to verify the identity of the product. Sewage produced the greatest amount of the carcinogenic NDEIA, while water from Cayuga Lake produced considerably less. The least amount of NDEIA was produced by water from an acid lake. The amount of DEIA added and the nitrite level in samples of the environment were found to be related to the amount of the nitrosamine formed. When samples of sewage and water from Cayuga Lake were autoclaved, NDEIA was either not formed or formed at rates much lower than in nonsterile environments. These results indicate that microorganisms or some other heat-labile factor may play a role in the formation of the nitroso compound. Although the nitrosamine could be metabolized in all three environments investigated, it persisted in lake water samples taken in the winter. (Carroll-FRC)

W82-00796

#### MEASUREMENT OF IN SITU RATES OF NITRIFICATION IN SEDIMENT,

Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.  
K. Henriksen. Microbial Ecology, Vol 6, No 4, p 329-337, 1980. 4 Fig, 2 Tab, 14 Ref.

Descriptors: \*Nitrification, \*Sediments, \*Chemical reactions, Ammonium, Sediment sampler, Inhibitors, In situ tests, Oxygen, Bacteria, Chemical analyses, \*Marine sediments.

High numbers of nitrifying bacteria occur below the zone of oxygen penetration in marine sediments and can almost immediately oxidize ammonium when supplied with oxygen. As a result, sampling methods which introduce oxygen into anoxic parts of the sediment can be expected to give potential rather than actual nitrification rates. This paper reports the development of a method for the measurement of nitrification rates in intact sediment cores without disturbing the concentration gradients of oxygen and ammonium. N-serve (2-chloro-6-trichloromethyl-pyridine) is a specific inhibitor of the nitrifying bacteria *Nitrosomonas* in oxidizing ammonium to hydroxylamine, the first step in the nitrification process. Injection of 20 parts per million (ppm) of N-serve into a 0.2 centimeter surface layer of the sediment and addition of 5 ppm N-serve to the water column of sediment cores was sufficient to inhibit nitrification, but did not change the rate of ammonium production or incorporation in sediment suspensions. The sediments were incubated aerobically and anaerobically. The ammonium accumulation in sediment cores injected with N-serve was equal to the amount of ammonium which was oxidized to nitrate in the control cores. Nitrification rates measured by this method were in the range of 0 to 3 millimolecules of nitrogen per square meter per day. The agreement of this finding with the findings of previous studies substantiates the conclusion that this method gives near in situ nitrification rates. (Carroll-FRC)  
W82-00798

#### URANIUM CONCENTRATION IN THE GROUND WATERS OF THE PULLMAN-MOSCOW BASIN, WHITMAN COUNTY, WASHINGTON, AND LATAH COUNTY, IDAHO,

Washington State Univ., Pullman. R. L. Albrook Hydraulic Lab.

For primary bibliographic entry see Field 5B.  
W82-00809

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

SAMPLING GROUND WATER FOR ORGANIC CONTAMINANTS, Oklahoma State Univ., Stillwater. Dept. of Geology.

W. A. Pettyjohn, W. J. Dunlap, R. Cosby, and J. W. Keeley. *Ground Water*, Vol 19, No 2, p 180-189, March/April, 1981. 8 Fig, 7 Ref.

Descriptors: \*Water sampling, \*Groundwater pollution, \*Laboratory equipment, Water quality, Wells, Sampling, Sample preparation, Pollutant identification.

Current preferred methods for the sampling of organic pollutants in groundwater are described which are used at the Ground Water Research Branch of the Robert S. Kerr Environmental Research Laboratory. For an effective sampling program, sampling equipment must be constructed of materials that have the least potential for affecting the sample, including glass and Teflon. Wells used to sample groundwater should be drilled and completed using techniques that minimize potential contamination of the aquifer. Teflon tubing can be used to case that portion of the well that extends from a few feet above the water table to the bottom of the borehole. Grab samples can be withdrawn through a sterile 6 mm Teflon tube and discharged into a sterile, calibrated one-liter heavy-wall Erlenmeyer flask with a peristaltic pump. For sampling at greater depths, a noncontaminating submersible high-lift pump can be used. Continuous sampling can utilize a system in which the water is pumped directly from the well through 6 mm Teflon tubing to two columns of adsorbent in series. Sampling systems are installed in specially constructed housings and form self-contained, easily transported units. (Small-FRC)

W82-00820

A REDUCTION-SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF SULPHATE IN WATERS, Sydney Univ. (Australia). Dept. of Inorganic Chemistry.

Rama S. Bhat, J. M. Eckert, and N. A. Gibson. *Analytica Chimica Acta*, Vol. 128, p 263-267, 1981. 2 Tab, 7 Ref.

Descriptors: \*Water analysis, \*Sulfates, Estuarine environment, Seawater, Natural waters, Chemical analysis, \*Spectrophotometry.

The reduction spectrophotometric method presented for the determination of sulfate in waters is based on the reduction of the sulfate by tin(II) chloride in hydroiodic acid to hydrogen sulfide, which is then swept by nitrogen into a buffered solution of bis(2,9-dimethyl-1,10-phenanthroline)copper(II) ion. The resulting copper(I) complex is measured spectrophotometrically. With sample volumes between 10 and 1000 microliters, the limit of detection is 0.5 micrograms of sulfate. Formation of the stable complex is immediate and the reduction system can be used repeatedly. The method is applicable to fresh, estuarine, and marine waters. The common inorganic sulfur containing anions such as sulfide, sulfite, thiosulfate, tetrathionate and dithionate interfere quantitatively with the proposed method, as they are all reduced by hydrogen sulfide with the same efficiency as sulfate. No interference was present from linear alkylbenzene sulfonates. The major ions of sea water do not interfere seriously, and the method may be used without modification for the determination of sulfate in marine and estuarine waters. (Baker-FRC)

W82-00850

EVALUATION OF AN AUTOMATIC SYSTEM FOR DETECTION OF TOXIC SUBSTANCES IN SURFACE WATER USING TROUT, Antwerpse Waterwerken (Belgium).

F. Van Hoof.

Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 221-225, 1980. 2 Tab, 10 Ref.

Descriptors: \*Toxicity, \*Bioindicators, \*Monitoring, \*Trout, Fish physiology, Water pollution, Ex-

perimental design, Chemical analysis, \*Surface water, Streams, Sewage treatment, Environmental effects, Metabolism, Sewage effluent.

An automatic system for detection of toxic substances in surface water is evaluated. The system uses rainbow trout as test organisms, since toxicity data on fish can be more easily extrapolated to mammals than results obtained with organisms having a lower level of bioorganization. Fish in aquaria were exposed to eight chemicals representing widely used pesticides and other polluting discharges. Avoidance reactions, loss of condition or death were monitored by a set of photoelectric cells placed at the downstream end of the flow-through aquarium. No conclusive evidence of toxicity was observed for cadmium, zinc, and ethylparathion. Potassium cyanide was the only product to elicit a clear avoidance response. Carbaryl, malathion, dinitroorthocresol, and captan caused death. These results are used in calculations of lethal dose concentrations; however, they do not take into account any safety margin. The biomonitoring parameters, i.e., positive rheotaxis and opercular rhythm in fish, oxygen production and oxygen consumption in bacteria, and mobility inhibition in daphnia may be useful when results from flow-through monitoring are inadequate. (Titus-FRC)

W82-00855

DETECTION OF VOLATILE NITROSAMINES IN WASTE WATER FROM CHEMICAL PLANTS BY COMBINED CAPILLARY GAS CHROMATOGRAPHY-MASS SPECTROMETRY, Mainz Univ. (Germany, F.R.). Hygiene Inst.

G. Hartmetz, and J. Slemrova.

Bulletin of Environmental Contamination and Toxicology, Vol 25, No 1, p 106-112, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: \*Volatility, \*Waste water, \*Chemical wastes, \*Mass spectrometry, \*Gas Chromatography, Industrial wastes, Carcinogens, Drinking water, Potable water, Water treatment, Water sampling, Chemical analysis, Sea water, Brackish water, Chemical wastewater, Pharmaceutical wastewater.

Seven samples of crude water from different wastewater treatment facilities and the purified waste water from a chemical-pharmaceutical plant were examined for carcinogenic materials. Concentrations of nitrosamines in the purification works effluent varied considerably with time. Findings show that volatile nitrosamines are introduced into the surface water through the waste water of chemical plants. The nitrosamine concentrations in the waste water are of the same order of magnitude as in various foodstuffs. Concentrations are so dilute in rivers as to be undetectable. (Titus-FRC)

W82-00856

SERUM ENZYMES IN RAINBOW TROUT AS TOOLS IN THE DIAGNOSIS OF WATER QUALITY, Innsbruck Univ. (Austria). Inst. fuer Zoophysiology.

W. Wieser, and S. Hinterleitner.

Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 188-193, 1980. 1 Tab, 15 Ref.

Descriptors: \*Fish physiology, \*Blood, \*Toxicity, \*Bioindicators, Water pollution, Experimental design, Chemical analysis, Trout, Streams, Sewage treatment, Environmental effects, Enzymes, Metabolism, Ammonia, Nitrate, Nitrite, \*Sewage effluent, Water pollution effects.

Stress responses of trout (*Salmo gairdneri*) brought about by deterioration of water quality are investigated. The activities of two transaminases in the trout serum were measured and the quality of the river water was analyzed at areas where the fish were caught. Samples were obtained at various distances from a sewage outfall. The transaminase activity was found to be a function of distance from the sewageplant and to be correlated with the

nitrogen content of the river water. The behavior and appearance of liver and gills of fish showed no variation from normal. Specimens caught within the plume had high values of serum glutamic oxaloacetic transaminase (SGOT) and glutamic pyruvate transaminase (GPT) activity. The levels of SGOT and SGPT activity in *S. gairdneri* appear to be good indicators of certain types of water pollution, at least within a range characterized by total ammonia concentrations of approximately 0.5 to 12 mg/liter. Trout in natural waters, in contrast to laboratory conditions, appear to tolerate surprisingly high local pollutant concentrations. (Titus-FRC)

W82-00857

METHODS OF INVESTIGATING THE STATE OF METAL IONS IN NATURAL WATERS, Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.

P. N. Linnik, and B. I. Nabivannet.

Water Resources (English Translation), Vol 7, No 3, p 463-477, September/October, 1980. 3 Fig, 1 Tab, 162 Ref. Translated from *Vodnye Resursy*, No 5, p 148-170, September/October, 1980.

Descriptors: \*Metals, \*Water analysis, \*Measurement techniques, \*Ions, Colloids, Suspended solids, Dissolved solids, Chemical analysis, Physical analysis, Separation techniques, Ionization, Hydrolysis, Oxidation.

Information concerning the forms of metal ions in natural waters is needed for developing an understanding of mechanisms for the assimilation of metals by aquatic organisms, for developing hydrochemical methods of prospecting for mineral resources, and for developing effective water treatment processes. This state-of-the-art review describes methods being used for the investigation and quantification of the forms of migration of metals in natural waters, including the distribution of metal between suspended, colloidal, and truly dissolved forms; the concentration of free noncomplexed ions of the investigated metals; the sign of the charge of the metal ions; the molecular (ionic) weight of complex or polynuclear compounds; complexation of metal ions in natural waters (kinetics of complexation, degree of complexation, strength of binding the metal into complex compounds, and complexing capacity of natural waters); and degree of oxidation (Valency) of the metal. The possibilities and limitations of each of the measurement techniques described are discussed. It is now possible to create general schemes for a systematic study of forms of migration of metal in complex natural waters. Three such general schemes are discussed. One of these schemes, developed by the authors of the article, permits the development of information on the state of metal ions in natural waters which is sufficiently complete to satisfy the needs of various specialists engaged in the problems of the study and use of natural waters. This scheme includes the successive use of various methods of investigation, permitting a quantitative determination of the portion of individual forms of the investigated element. (Carroll-FRC)

W82-00859

EFFECT OF TURBIDITY ON CHLORINATION EFFICIENCY AND BACTERIAL PERSISTENCE IN DRINKING WATER, Oregon State Univ., Corvallis. Dept. of Microbiology.

M. W. LeChevallier, T. M. Evans, and R. J. Seidler.

Applied and Environmental Microbiology, Vol. 42, No. 1, p 159-167, July, 1981. 7 Fig, 1 Tab, 29 Ref.

Descriptors: \*Drinking water, \*Turbidity, \*Chlorination, Disinfection, \*Bacteria, Water quality, Potable water.

The influence of turbidity on drinking water quality was examined in six watersheds where turbidities at entry points to distribution lines ranged from 0.2 to 15.0 nephelometric turbidity units (NTU). Coliform densities in raw water ranged from 11 to 500 coliforms per 100 ml, and were reduced 10- to

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

1,000-fold by chlorination. Coliforms in high-turbidity water (13 NTU) were reduced to only 20% of the initial count, whereas coliforms in low turbidity water (1.5 NTU) were undetectable even when large volumes were sampled, indicating a 1,000-fold or greater decrease. Disinfection efficiency was found to be negatively correlated with turbidity. Turbid water samples were examined in an attempt to determine factors which aid bacteria in surviving exposure to chlorine. Some bacteria particles were either embedded in turbidity particles or appeared to be coated with amorphous material or both. Blending of chlorinated turbid water increased the number of standard plate count bacteria as much as five times, indicating the physical separation of cells attached to common particles. The chlorine demand of the surface water supplies was positively correlated with both the turbidity and total organic carbon content of the water, but not with other chemical parameters. It was concluded that turbidity is a useful indicator of potential problems in drinking water. (Baker-FRC) W82-00865

#### GOOD LOOKS, LOW MAINTENANCE GUIDE WATER TANK CHOICE, K. Grover.

American City and County, Vol. 95, No. 12, p 19-22, December, 1980.

Descriptors: \*Water tanks, \*Water storage, \*Maintenance costs, \*Design criteria, \*Concrete construction, Storage tanks, Pipes, Materials engineering, Cost analysis, Economic aspects, Design standards, Pumps, Pumpage, Construction, Construction costs.

The design and cost of various water tanks is discussed, and examples of tanks currently in operation are cited. The three basic types of tanks used today are ground storage reservoirs, standpipes, and elevated tanks. Steel and concrete are the standard construction materials. For utilities and districts with storage needs in excess of 1.5 million gallons, tanks are constructed of welded steel or prestressed concrete, while bolted steel is appropriate for smaller tanks. Topography of the service area, availability and cost of land, and the type of water system are the prime factors influencing the choice of design. Elevated tanks assure constant pressure, accommodate variable demand, and can reduce pumpage costs. Standpipes are useful where there is some need for pressure equalization. Ground storage often offers lowest first cost and maintenance costs. It is safer and more convenient, and avoids aesthetic problems. However, land acquisition and excavation costs may be high. The newest innovation in design is the multi-use elevated tank which provides space inside for offices, pumps, controls, and storage. These are in operation in over 100 towns in the United States. (Titus-FRC) W82-00868

#### DETERMINATION OF LOW NG/L LEVELS OF POLYCHLORINATED BIPHENYLS IN DRINKING WATER BY EXTRACTION WITH MACRORETICULAR RESIN AND ANALYSIS USING A CAPILLARY COLUMN, Environmental Health Directorate, Ottawa (Ontario).

G. L. LeBel, and D. T. Williams.  
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 397-403, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: \*Drinking water, \*Phenols, \*Organic compounds, Water pollution, Contamination, Potable water, Streams, Groundwater, Chlorination, Chlorine, Gas chromatography, Water sampling, Monitoring, Experimental design, \*Pollutant identification, \*Polychlorinated biphenyls.

The application of the XAD-2 macroreticular method to analyze large volumes of potable water for low volumes of polychlorinated biphenyls was investigated. Contributions to the procedural blank value and the interference from other organic materials in a water sample were examined. Quantitation of recovery runs was achieved by comparing

peak heights of selected peaks from the sample extracts with the corresponding peaks from standard polychlorinated biphenyl solutions. Results of tests run on well samples indicate that the detection limits are affected by the interference from other organics in the water sample but are typically in the 1 to 10 microgram per liter range for potable water from a river source. (Titus-FRC) W82-00875

#### OCCURRENCE OF TETRAALKYLEAD COMPOUNDS IN THE AQUATIC ENVIRONMENT, Canada Centre for Inland Waters, Burlington (Ontario).

Y. K. Chau, P. T. S. Wong, O. Kramar, G. A. Bengert, and R. B. Cruz.  
Bulletin of Environmental Contamination and Toxicology, Vol. 24, No 2, p 265-269, 1980. 1 Tab, 10 Ref.

Descriptors: \*Aquatic environment, \*Fish physiology, Fish populations, \*Water pollution, \*Toxicity, Microorganisms, \*Lead, Organic compounds, Primary productivity, Environmental effects, Ecosystems, Gas chromatography, Spectrophotometry, Sediment, Lakes, \*Tetraalkylead compounds.

Results of an extensive survey of fish, vegetation, sediment, and water for the presence of tetraalkylead compounds are presented. The samples were taken from various lakes and rivers in Ontario. Only fish samples were found to contain these compounds. The source of these compounds is thought to be antiknock gasoline additives or related commercial products. The fish containing tetraalkylead also contained high total and extractable lead. No relationship between species and size of fish or concentration of pollutant was detected. The type of tetraalkylead varied in different locations. Concentrations of the tetraalkylead were generally low, comprising less than 10 per cent of the total lead. (titus-FRC) W82-00878

#### DETERMINATION OF POLYHALOGENATED PHENOLIC COMPOUNDS IN DRINKING WATER, HUMAN BLOOD SERUM AND ADIPOSE TISSUE, Miami Univ., FL School of Medicine.

C. Morgade, A. Barquet, and C. D. Pfaffenberger.  
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 257-264, 1980. 5 Tab, 8 Ref.

Descriptors: \*Phenols, \*Drinking water, \*Halogens, \*Tissue analysis, \*Water sampling, Potable water, Organic compounds, Blood, Experimental design, Water pollution, Gas chromatography, Sensitivity analysis, Public health.

The blood serum of 58 women in Florida was analyzed for the presence of eight halogenated phenols, and the drinking water source for each woman was recorded. Chlorinated municipal water and nonchlorinated well water were the two sources of drinking water. Additionally, 10 samples of human adipose tissue, taken at autopsy, were analyzed. Results showed that blood serum levels of PCP were not dramatically different for the two groups of women. The concentrations in both groups were significantly below those reported for citizens in Hawaii. Tissue analyses indicate that PCP (pentachlorophenol) does not bioconcentrate in human adipose tissue to the same extent as DDT and DDE. The level of PCP in adipose tissue ranged from 0.01 to 0.08 parts per million. (Titus-FRC) W82-00879

#### ALUMINUM SHADOWING-DIRECT PROJECTION PHOTOMICROSCOPY OF DIATOM FRUSTULES,

Weyerhaeuser Co., Longview, WA.  
D. W. Quackenbush, and M. L. Bothwell.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1160-1166, July, 1980. 3 Fig, 24 Ref.

Descriptors: \*Diatoms, \*Microscopy, Bacteria, Phytoplankton, \*Photography, Water analysis, \*Environmental gradient, \*Ecology.

Accurate identification of diatom genera and species represents an important means of studying present and past environmental conditions in freshwater and marine ecosystems. The aluminum shadowing-direct projection method produced high resolution photomicrographic reproductions of diatom preparations in the 200 x 800 magnification range. This technique, which allows size determination in three dimensions, provides a simple and inexpensive alternative to low magnification scanning electron micrographs. Among the details revealed are valve surface contours, ridges and depressions, raised and depressed central areas of Cyclotella valves, external and internal valve views of pennate forms, and puncta of Stauroneis. A shadowing angle of 20 degrees gave the best results. By multiplying the measured length of shadows by tan 20 degrees, the depth of specimens or length of spines can be determined. Diatom identification and enumeration can be done directly from photographic prints, which are a permanent record. Another potential use of the method is in preparing permanent mounts for total free-living bacteria counts of water samples. (Cassar-FRC) W82-00884

#### THE IMPACT OF AN INDUSTRIALLY CONTAMINATED LAKE ON HEAVY METAL LEVELS IN ITS EFFLUENT STREAM, Purdue Univ., Lafayette, IN. Dept. of Bioinorganic Chemistry.

For primary bibliographic entry see Field 5B.

W82-00886

#### GRAB VERSUS COMPOSITE SAMPLING: A PRIMER FOR THE MANAGER AND ENGINEER,

Illinois Environmental Protection Agency, Springfield.  
D. J. Schaeffer, H. W. Kerster, and K. G. Janardan.  
Environmental Management, Vol 4, No 2, p 157-163, March, 1980. 1 Tab, 7 Ref.

Descriptors: Sampling, \*Water sampling, Water quality management, Effluents, Wastewater treatment, Monitoring, Regulations, Pollutant identification, Water analysis, Water pollution prevention, Simulation analysis, \*Wastewater analysis, \*Composite portion analysis, Sampling techniques.

Effluent samples are usually aggregated into 24-hr composite samples for measuring compliance. This paper shows by simulation analysis that random grab samples are as effective as composite samples for monitoring purposes and provide more information on plant variability. In addition, by using a constant volume compositing regime, a single composite of n subsamples provides as much information as do n grab samples. Monthly average performance measured by M composites is the same as that measured by M random grabs taken over the same period. M grab samples are equally or more informative than the monthly average derived from flow proportional composites. For judging average plant performance, composites are better than grabs; for long term performance, grabs and composites provide the same real information. Process extremes, particularly high values, are more readily revealed by grab samples than by composite samples. This allows earlier corrective measures for out-of-control plant operations and warnings on releases of momentarily high concentrations of toxic or high BOD effluents. (Cassar-FRC) W82-00891

#### PREFERENCE-AVOIDANCE REACTIONS OF CRAYFISH TO SUBLETHAL CONCENTRATIONS OF CADMIUM,

Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology.  
A. F. Maciorowski, E. F. Benfield, and J. Cairns, Jr.  
Hydrobiologia, Vol 74, No 2, p 105-112, September, 1980. 1 Fig, 4 Tab, 36 Ref.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

Descriptors: \*Cadmium, \*Bioindicators, \*Behavior, \*Crayfish, Invertebrates, Monitoring, Water quality, Metals, Animal behavior, Water pollution effects, Aquatic environment, Pollutant identification.

Crayfish (*Cambarus acuminatus*) were able to detect sublethal concentrations of cadmium and respond by changing their locomotion patterns. This suggests a possible use of crayfish in continuous biomonitoring systems. The alterations in locomotor patterns included: activity without directed movement, momentary cessation of directed movement at the contaminated-uncontaminated interface, attempts to leave the test chamber, and leaving and reentering the Cd zone. Tests were conducted in tanks using Cd concentrations of 125.0, 12.5, and 1.25 micrograms per liter. The crayfish tended to avoid the Cd area in the tank with the highest concentration and appeared to prefer the Cd side in the lower two concentrations. A possible explanation for this is that the pollutant disrupts chemosensory behavior, blocking taste receptors and natural stimuli. (Cassar-FRC)

W82-00916

#### HEAVY METAL CONCENTRATIONS IN THE HOLSTON RIVER BASIN (TENNESSEE), East Tennessee State Univ., Kingsport. Dept. of Chemistry.

G. J. Young, and R. D. Blevins.

Archives of Environmental Contamination and Toxicology, Vol 10, No 5, p 541-560, September, 1981. 1 Fig, 7 Tab, 71 Ref.

Descriptors: \*Heavy metals, \*Water analysis, \*Fish, Monitoring, Pollutant identification, Metals, Cadmium, Lead, Manganese, Zinc, Copper, Mercury, \*Holston River, \*Tennessee, Water pollution sources, Toxicity, Water pollution effects.

Heavy metals (Zn, Cd, Hg, Cu, Pb, and Mn) were measured in water samples and fish muscle from the Holston River Basin in Eastern Tennessee. This basin, encompassing 12 counties, contains both natural, unpolluted streams and waters heavily polluted by industrial and domestic uses. Maximum levels (in ppb) in water samples were: Zn, 1143; Mn, 637; Pb, 18; Hg, 0.6; Cd, 4; Cu, 68. In fish muscle maximum levels (in ppm) were: Cd, 0.41; Pb, 1.3; Mn, 4.3; Cu, 0.8; and Zn, 24. Median levels of Cd, Cu, Pb, and Zn in the Holston River Basin were at or below median values found in fish throughout the world; Mn levels were much higher. Serious Hg pollution problems downstream of a chlor-alkali plant operated from 1950 to 1972 were not reflected in grab water samples because large amounts of Hg are adsorbed on sediment. Fish muscle is a better indicator of Hg pollution than water samples. (Cassar-FRC)

W82-0099

#### SEA URCHIN SPERM BIOASSAY FOR SEWAGE AND CHLORINATED SEAWATER AND ITS RELATION TO FISH BIOASSAYS, Washington Univ., Seattle. Fisheries Research Inst.

P. A. Dinnel, Q. J. Stober, and D. H. DiJulio. Marine Environmental Research, Vol 5, No 2, p 29-39, 1981. 3 Fig, 2 Tab, 30 Ref.

Descriptors: \*Bioassay, \*Wastewater, \*Echinoderms, Chlorination, Toxicity, \*Seawater, Eggs, Fertilization.

Sea urchin sperm bioassay was used to assess the toxicity of a complex municipal wastewater and chlorinated seawater, and these results were compared with previous results obtained with fish. Green sea urchin or sand dollar sperm and eggs were exposed to chlorinated or unchlorinated primary sewage effluent or chlorinated seawater before fertilization of eggs. With 5-minute exposures to chlorinated sewage, eggs remained viable in up to 25% sewage while sperm viability decreased to 29% in 5% sewage and 0% in more than 10% sewage. Fertilization was successful after 5-minute exposures of the sperm to as much as 30% freshwater in seawater with a salinity of about 20 ppt, while sperm lost viability in 20% sewage/seawater dilutions. Fertilization success

was reduced by 50% by 2.2% chlorinated or 4.8% unchlorinated sewage in seawater. Sea urchin and sand dollar sperm were more sensitive than marine fish sperm to sewage and chlorinated seawater. Tests with sperm cells require only short exposure times under static conditions, thus this bioassay technique may be useful to researchers. (Small-FRC)

W82-00988

#### DETERMINATION OF PICOGRAM AMOUNTS OF TECHNETIUM-99 BY RESIN BEAD MASS SPECTROMETRIC ISOTOPE DILUTION,

DuPont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.

T. J. Anderson, and R. L. Walker.

Analytical Chemistry, Vol 52, No 4, p 709-713, April, 1980. 3 Fig, 3 Tab, 25 Ref.

Descriptors: \*Nuclear powerplants, \*Isotope studies, \*Mass spectrometry, Resins, Radioisotopes, \*Pollutant identification, Chemical analysis.

Accumulation of large amounts of technetium-99, which is produced in high yields from the fission of uranium-235 and plutonium-239, can be expected to occur concurrent with energy production by atomic fission. The volatility of technetium-99 and its aqueous mobility in soil systems create the potential for escape to the environment. This paper reports the development of an improved isotope dilution mass spectrometric technique for the analysis of technetium-99 in environmental samples. Sequential ion-exchange chromatography and ion-association solvent extraction are used to isolate technetium from a sample spiked with technetium-97. The isolated technetium is concentrated onto a pair of anion exchange beads having a diameter of about 0.3 millimeters, which are then individually analyzed on the rhodium "V" filaments of a surface-ionization mass spectrometer. The resin bead source provides an enhanced ionization efficiency capable of permitting determination of as little as 1 picogram of technetium. This technique was used for the analysis of several environmental samples from the vicinity of the Savannah River Plant, a nuclear materials production complex. These analyses showed that technetium-99 has high mobility in water-saturated soil and that technetium-99 concentrations in the seepage basins can be expected to vary substantially with reprocessing parameters. The contribution of technetium-99 to the Savannah river was assessed by comparing upstream and downstream samples and gave an annualized instantaneous release rate to the aqueous environment of 0.05 Ci/yr. (Carroll-FRC)

W82-00999

#### A RAPID SIMPLE LONG-TERM TOXICITY ASSAY FOR AQUATIC CONTAMINANTS USING THE NEMATODE PANAGRELLUS RE-DIVIVUS,

Manitoba Univ., Winnipeg. Dept. of Zoology. M. R. Samoiloff, S. Schulz, Y. Jordan, K. Denich, and E. Arnott.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1167-1174, July, 1980. 6 Tab, 10 Ref.

Descriptors: \*Bioassays, \*Water pollution effects, \*Nematodes, Carcinogens, Aquatic animals, \*Heavy metals, Toxicity, Pesticide toxicity, Pesticides, Physiological ecology, Water pollution, Assay, Bioindicators.

Two bioassay methods (one developmental, the other mutagenic) for determining the effects of aquatic environmental contaminants to the nematode *Panagrellus redivivus* are presented. The nematodes were tested with 15 known carcinogens or mutagens, 6 suspect carcinogens, and 7 heavy metals at levels of 0.01 to 1,000 micromoles/liter. An assay based on frequency of completion of postembryonic molts showed that 24 of the 28 test agents caused an increased mortality to *P. redivivus*. Twelve of the known carcinogens and one heavy metal caused lethal mutations in nematode chromosome assays. These assays are recommended for the detection of toxic effects to aquatic

organisms due to chronic exposure to environmental water pollutants. (Geiger-FRC)

W82-01017

#### RELATION BETWEEN TROPHIC POSITION AND MERCURY ACCUMULATION AMONG FISHES FROM THE TONGUE RIVER RESERVOIR, MONTANA,

Montana Cooperative Fishery Research Unit, Bozeman.

G. R. Phillips, T. E. Lenhart, and R. W. Gregory. Environmental Research, Vol 22, No 1, p 73-80, June, 1980. 3 Fig, 30 Ref.

Descriptors: \*Reservoirs, \*Fish, \*Mercury, Toxicity, Accumulation, \*Bioaccumulation, Methylmercury, Organic compounds, Mining industry, \*Tongue River Reservoir, \*Montana.

Fish were collected from the Tongue River Reservoir during spring and summer 1978 using trap nets or gill nets. Total mercury in fish was determined using an atomic absorption spectrophotometer. Mercury concentrations in muscle tissue from all five species of fish increased with fish length. This increase in contamination with increasing length is primarily a result of the long biological half-time of methylmercury in fishes. Male northern pike contained higher mercury concentrations than did females of similar length. This trend was a result of the slower growth of males relative to females. Mercury concentrations in some individuals of all species analyzed exceeded the FDA guideline. Maximum mercury concentrations in microgram mercury/gram observed were as follows: Northern pike 1.53, sauger 1.40, walleye 1.30, black crappie 0.64, and white crappie 0.60. Mercury concentrations in northern pike were particularly high, with 29% of the fish analyzed exceeding the FDA guidelines. Northern pike and saugers accumulated mercury nearly twice as fast as did the two species of crappie. The rate for walleyes was intermediate. It was concluded that planktivores derive most of their methylmercury body burden from water, but that piscivores receive a significant amount from both diet and water. (Baker-FRC)

W82-01041

#### DISPERSAL OF SALMONELLA FROM A POLLUTED STREAM TO NEIGHBORING TERRESTRIAL HABITATS,

Elmhurst Coll., IL. Dept. of Biology.

F. C. Mittermeyer, D. Cramer, and R. Ransford. Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 269-281, 1980. 1 Fig, 1 Tab, 8 Ref.

Descriptors: \*Human diseases, \*Salmonella, \*Bacterial analysis, Rivers, Surface waters, Sediments, Shores, Shoreline cover, Soil analysis, Bacteria, River water, Water pollution sources, Path of pollutants, \*Illinois.

Environmental samples were collected from the Fox River and adjacent areas in Kane County, Illinois. Seven sampling sites were chosen from within the suburban municipalities of St. Charles, Geneva, Batavia, and North Aurora. During the first four months of the study the greatest efficiency of *Salmonella* recovery was achieved using BPW pre-enrichment followed by enrichment in BGTEI and subsequent plating onto Brilliant Green Agar. This procedure was used exclusively thereafter. Twenty-three percent of grass samples taken from the river's edge were positive for *Salmonella*. Grass samples taken more than 2 meters from the river were all negative. Soil samples taken from the top 10 cm of the ground about 3 meters from shoreline were usually negative. *Salmonella heidelberg* was the only serotype found in the sediment samples. Attempts to isolate *Salmonella* from surface swabs of picnic tables, trees, poles, bridges, and other surfaces within 15 meters of the river were unsuccessful. Some animals associated with the polluted river were found to be infected with *Salmonella*. However, general findings lead to the conclusion that the river is not an intensive *Salmonella* threat to humans, except perhaps those who directly contact the water. (Baker-FRC)

W82-01043

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

**GIARDIA PREVALENCE IN COMMERCIALLY TRAPPED MAMMALS,**  
Washington State Dept. of Social and Health Services, Olympia, Office of Environmental Programs, F. Frost, B. Plan, and B. Liechty, Journal of Environmental Health, Vol 42, No 5, p 245-249, March/April, 1980. 5 Tab, 13 Ref.

Descriptors: \*Water quality, \*Drinking water, Giardia, Watersheds, Parasites, Potable water, \*Contamination, Public health, Water pollution sources, Mammals, Protozoa, Chlorination, Beaver, Epidemiology, \*Municipal water, Animal parasites.

Several recent outbreaks of giardiasis have been linked to the presence of Giardia in municipal water supplies. In most cases human or animal contamination of drinking water has been implicated. Since chlorine may not be effective in inactivating cysts, the risk of human infection through contaminated drinking water may be significant. Commercial trappers were recruited to provide stool samples from kill-trapped animals. During the three years of the study 704 fecal samples were examined. Parasites were found in all species of animals; however, only the beaver and muskrat harbored Giardia. The percentage of Giardia-positive animals increased each year, due to the detection of infected animals in previously negative counties and to a higher prevalence of Giardia infections in animals from previously positive counties. In the second and third years, Giardia prevalence in muskrats was higher than in beavers. The finding of infected animals in the Jones Creek/Boulder Creek, Cedar River, and Green River watersheds suggests that beavers can maintain the infection independent of human involvement. This indicates that human sewage is not necessary to sustain infections among wild beaver. It also suggests that protected watersheds will not insure pathogen-free water. (Baker-FRC)  
W82-01046

**BIOLOGICAL TESTING METHODS - COMPLIANCE WITH HAZARDOUS WASTE REGULATION CHAPTER 173-302 WAC.**  
Washington State Dept. of Ecology, Olympia. Document DOE 80-12, October, 1980. 24 p, 1 Fig, 3 Tab.

Descriptors: \*Fishkill, \*Waste characteristics, \*Hazardous materials, \*Waste identification, \*Fish toxins, Fish populations, Testing procedures, Toxicity, Test facilities, Poisons, Mortality, Lethal limit, Laboratory animals, \*Washington.

The purpose of Washington's acute fish toxicity test is to provide a simple, reliable, low-cost method for testing the toxicity of a material against the requirements of the Hazardous Waste Regulation, Chapter 173-302 WAC. The test method developed, described in Part A of the report, is strictly a range-finding test and does not determine the actual median lethal concentration, which is defined as the concentration of material that kills 50 percent of the population (fish) within 96 hours. The method, incorporating test organisms in holding tanks in a constant-temperature room or recirculating water batch, follows the requirements of Chapter 173-302 WAC, which states that if the toxicity is not known, the waste must be tested at two concentrations: 100 mg/l and 1000 mg/l. Wastes that are highly toxic and kill fish at 100 mg/l are considered extremely hazardous, while wastes that kill fish at 1000 mg/l are considered dangerous wastes. Part B of the report describes oral rat testing whose purpose is to determine the relative biological risk of potentially hazardous waste to man and wildlife. Male albino rats weighing 200-300 grams are used for test and control animals. Wastes are introduced into the stomachs by a tube. Ten rats are used at each dosage level, and ten rats for each positive control test. Oral rat tests are used whenever a generator does not characterize the toxicity of a waste because of a lack of knowledge of the chemical composition and presence of toxic constituents, a lack of knowledge of the biological hazards of toxic constituents or the waste as a whole, and/or the inability to book-designate a waste's biological toxicity. (Garrison-Omniplan)  
W82-01071

#### DETERMINATION OF ALKALINE EARTH AND DIVALENT TRANSITION METAL CATIONS BY ION CHROMATOGRAPHY WITH SULFATE-SUPPRESSED BARIUM AND LEAD ELUENTS,

Brigham Young Univ., Provo, UT. Dept. of Chemistry.

F. R. Nordmeyer, L. D. Hansen, D. J. Eatough, D. K. Rollins, and J. D. Lamb.

Analytical Chemistry, Vol 52, No 6, p 852-856, May, 1980. 2 Fig, 5 Tab, 8 Ref.

Descriptors: \*Water analysis, \*Metals, Magnesium, Calcium, Strontium, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Cadmium, Lakes, Ponds, Measuring instruments, \*Chromatography.

The development of simple eluent-suppressor systems is reported. These systems allow the simultaneous ion chromatographic determination of Mg(2+), Ca(2+), and Sr(2+), and individual determinations of Mn(2+), Fe(2+), Co(2+), Ni(2+), Cu(2+), Zn(2+), and Cd(2+). Aqueous Ba(2+) and Pb(2+) which serve as eluting ions are suppressed as insoluble sulfates in a suppressor column initially loaded with SO4(2-). An H(+) exchange postcolumn is placed between the suppressor and detector, serving to minimize the effect of pH on the conductometric base line and amplify divalent cation peak heights by a factor of about 5, thus greatly increasing the sensitivity of the technique. The major advantage of the method is the wide range of eluent pH which becomes available. Thus transition metal cations can be eluted in acidic solution without being exposed to a neutral or alkaline environment at any point in the system. Use of the ion chromatographic technique described for the analysis of Mg(2+) and Ca(2+) in pond water samples is described. The samples were analyzed both by ion chromatography using the 1 mM Ba (NO3)2 eluent at pH 4 with the post-column in line and by atomic absorption spectrometry. The results from the two techniques never differed by more than 3%. (Baker-FRC)  
W82-01082

#### WATER HARDNESS DETERMINATION BY THE CATALYTIC POLAROGRAPHIC WAVE OF MAGNESIUM ION,

Foxboro Co., MA.

M. C. Cheney, D. J. Curran, and K.S. Fletcher, III.

Analytical Chemistry, Vol 52, No 6, p 942-945, May, 1980. 2 Fig, 1 Tab, 18 Ref.

Descriptors: \*Water analysis, \*Magnesium, Chemical analysis, \*Hardness, Measuring instruments, Polarographic analysis, Chemical properties.

A water hardness measurement technique is presented which is based on the stoichiometric displacement of magnesium from its relatively weak EDTA complex by most divalent metal ions. Subsequent determination of free Mg(2+) using the catalytic wave that results when it is reduced at the dropping mercury electrode provides a substantial amplification effect. Though the relationship between observed catalytic current and concentration of Mg(2+) is linear over a relatively narrow range of concentration, the technique offers a rapid and sensitive method for determination of water hardness. Samples of tap water, well water, and an artificially prepared hard water containing 25.0 ppm Ca(2+) and 20.0 ppm Mg(2+) were analyzed by this method and by the standard EDTA titration method. Results were accurate to within 1% of the titration values and precision was on the order of 1%. (Baker-FRC)  
W82-01083

#### DETERMINATION OF CHROMIUM SPECIATION IN NATURAL WATERS BY ELECTRO-DEPOSITION ON GRAPHITE TUBES FOR ELECTROTHERMAL ATOMIZATION,

Australian Atomic Energy Commission Research Establishment, Lucas Heights.

G. E. Batley, and J. P. Matousek.

Analytical Chemistry, Vol 52, No 11, p 1570-1574, September, 1980. 6 Fig, 1 Tab, 22 Ref.

Descriptors: \*Natural waters, \*Chromium, \*Water analysis, Chemical analysis, Electrothermal atomization, Electrochemistry.

Studies of the electrodeposition-atomization technique and its potential for the analysis of chromium species in seawater are described. Matrix interferences can be overcome and preconcentration achieved by the electrodeposition of chromium with mercury onto pyrolytic graphite-coated tubular furnaces using a flow-through assembly. At pH 4.7, using a deposition potential of -1.8 V vs. SCE, both Cr(VI) and Cr(III) are reduced and accumulated as metallic chromium. At the same pH, but at -0.3 V vs. SCE, only Cr(VI) is selectively reduced to Cr(III), which accumulates by adsorption. Using the labile-bound discrimination of the electrodeposition technique combined with an ultraviolet irradiation step, Cr(VI) was found to be dominant in the samples studied, with most Cr(VI) present as labile forms. (Baker-FRC)  
W82-01084

#### ORGANIC MATRIX MODIFIERS FOR DIRECT GRAPHITE FURNACE ATOMIC ABSORPTION DETERMINATION OF CADMIUM IN SEAWATER,

National Research Council of Canada, Halifax (Nova Scotia), Atlantic Regional Lab. R. Guevremont.

Analytical Chemistry, Vol 52, No 11, p 1574-1578, September, 1980. 3 Fig, 4 Tab, 17 Ref.

Descriptors: \*Seawater, \*Cadmium, Water analysis, Chemical analysis, Spectral analysis, Atomic absorption spectrometry, Reagent.

The application of citric acid, lactic acid, aspartic acid, histidine, and EDTA to direct graphite furnace analysis of cadmium in seawater is described. The agreement between analyses performed using the different reagents was very good. The application of EDTA gave results in good agreement with APDC/MIBK solvent extraction followed by graphite furnace atomic absorption and with ion exchange on Chelex-100 resin followed by isotope dilution spark source mass spectrometry. Citric acid appeared to be the most promising reagent used thus far. The sensitivity possible with this reagent is higher and the background interferences were small and easily controlled. The major difficulty with this reagent is the shortness of the atomic absorption signal. The lowest standard deviation in the measurement of cadmium in seawater was obtained using aspartic acid. In seawater this reagent had excellent sensitivity and low background absorbance. In deionized water, however, it did not promote low temperature atom production to the extent possible using citric acid or lactic acid. (Baker-FRC)  
W82-01085

#### COMPARISON OF METHODS FOR THE DETERMINATION OF TRACE ELEMENTS IN SEAWATER,

National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.

R. E. Sturgeon, S. S. Berman, J. A. H. Desaulniers,

A. P. Mykytiuk, and J. W. McLaren.

Analytical Chemistry, Vol 52, No 11, p 1585-1588, September, 1980. 3 Tab, 16 Ref.

Descriptors: \*Seawater, \*Chemical analysis, \*Trace elements, Water analysis, Metals, Cadmium, Zinc, Lead, Iron, Manganese, Copper, Nickel, Cobalt, Chromium, Atomic absorption spectrometry, Emission spectroscopy, Ion exchange.

The analysis of coastal seawater for Cd, Zn, Pb, Fe, Mn, Cu, Ni, Co, and Cr was carried out using isotope dilution spark source mass spectrometry (IDSSMS), graphite-furnace atomic absorption spectrometry (GFAAS), and inductively coupled plasma emission spectrometry (ICPES) following trace metal separation-preconcentration using ion-exchange and chelation-solvent extraction, and direct analysis by GFAAS. Cu, Ni, Pb, Cr, and Co could not be measured by direct GFAAS in the stored seawater samples because of their inherently low concentrations and/or pronounced physico-chemical matrix interference effects. Manganese

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

could not be determined by ICPES using a 25-fold preconcentration of the trace elements, as their levels in such concentrates remain below values at which reliable analysis can be performed. Overall good agreement was obtained between the elemental values in relation to the method of analysis. The precision of replicate determination between methods for all elements is comparable. Complete analysis of each sample by all the methods indicated usually required about two months. The results of this study give confidence in the ability of the individual methods to give accurate analytical data and in the effectiveness of the standard addition approach in compensating for physicochemical interferences arising during sample preconcentration and instrumental analysis. (Baker-FRC)  
W82-01086

**ENTERIC VIRUSES IN RENOVATED WATER IN MANITOBA,**  
Cadham Provincial Lab., Winnipeg (Manitoba).  
L. Sekla, W. Stackiw, C. Kay, and L.  
VanBuckenhoult.

Canadian Journal of Microbiology, Vol 26, No 4, p

518-523, 1980. 4 Tab, 31 Ref.

Descriptors: \*Viruses, \*Wastewater renovation, Water reuse, Water shortage, Wastewater treatment, Drinking water, Potable water, Effluents, Rivers, Water analysis, \*Manitoba, Canada.

This paper reports on procedures used in, and the findings obtained from, recovering enteric viruses from a Manitoban waterway system consisting of a sewage treatment plant, a river, and a water treatment plant. Both the liquid and the solid (sludge) components of sewage were sampled. The viruses isolated from raw sludge, sewage, final effluent, river water, and drinking water are listed. Of the 57 poliovirus isolates from sewage, 22 were tested and found to be vaccine strains. All three viruses isolated from the river were obtained from the same sample, collected at the middle of the river near the outlet of the sewage treatment plant in October of 1978. Thirteen of the isolates from drinking water were found on samples taken 2 days apart. The first 14 isolates found were confirmed as vaccine strains. This study has demonstrated the presence of enteric viruses in sewage and drinking waters, thus confirming the hypothesis that viruses can be recycled. The presence of enteric viruses in 61.8% of the sewage samples was expected. The presence of enteric viruses in 20.5% of the final sewage effluent samples was also expected. The recovery of enteric viruses from 6.75% of the drinking water samples is a matter of concern. All viruses so recovered were polioviruses, and those tested were found to be vaccine strains, a sequel to the extensive immunization program carried out in Manitoba since 1962. (Baker-FRC)  
W82-01090

**MULTIELEMENT PRECONCENTRATION OF TRACE HEAVY METALS IN WATER BY CO-PRECIPITATION AND FLOTATION WITH INDIUM HYDROXIDE FOR INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY,**  
Nagoya Univ. (Japan).  
M. Miraide, T. Ito, M. Baba, H. Kawaguchi, and A. Mizuke.  
Analytical Chemistry, Vol 52, No 6, p 804-807, May, 1980. 2 Fig, 4 Tab, 3 Ref.

Descriptors: \*Heavy metals, \*Water analysis, Measuring instruments, Chemical analysis, Chromium, Manganese, Nickel, Cobalt, Cadmium, Lead, Spectrometers, Spectral analysis, Analytical techniques.

Microgram quantities of Cr(III), Mn(II), Co, Ni, Cu(II), Cd, and Pb in 1200-ml samples were quantitatively coprecipitated with indium hydroxide at a pH of 9.5. After adding ethanolic solutions of sodium oleate and dodecyl sulfate, the precipitates are floated with numerous tiny nitrogen bubbles to the solution surface, and then collected in a small sampling tube. The procedure is simple and rapid, and suitable for operation at sampling spots. The heavy metals in the dissolved precipitates are determined by inductively coupled plasma-atomic

emission spectrometry. The concentrations of the heavy metals are increased 240-fold, and those of alkali and alkaline earth metals in artificial seawater are reduced to 1/50-1/20 for sodium and potassium, and about 1/2 for magnesium, calcium, and strontium. Heavy metals at the low microgram/liter level in water or artificial seawater were simultaneously preconcentrated and determined by this procedure. The time required for preconcentration was about 40 minutes. (Baker-FRC)  
W82-01097

#### DETERMINATION OF MOLYBDENUM IN SEA AND ESTUARINE WATER WITH BETA-NAPHTHOIN OXIME AND NEUTRON ACTIVATION,

Dalhousie University, Halifax (Nova Scotia). Dept. of Chemistry.

A. I. Kulathilake, and A. Chatterjee.  
Analytical Chemistry, Vol 52, No 6, p 828-833, May, 1980. 1 Fig, 9 Tab, 53 Ref.

Descriptors: \*Water analysis, \*Molybdenum, Chemical analysis, Seawater, Neutron activation analysis, Estuaries, Trace elements, Heavy metals.

An analytical method for the determination of trace quantities of molybdenum in sea and estuarine water employing neutron activation analysis preceded by preconcentration of the element using beta-naphthoin oxime is presented. Radioactive tracers were used to investigate the various factors which can influence the sensitivity of the method. Concentrations of sodium, chlorine, and bromine in untreated seawater and cocrystallized product have been compared for evaluating the ability of beta-naphthoin oxime to reduce interferences from these three elements. Selectivity of beta-naphthoin oxime in preconcentrating molybdenum was studied using two diverse matrices, seawater and steel, which are known to contain several elements at drastically different concentrations. Molybdenum concentrations in samples of sea and estuarine water were determined with good precision and accuracy by this method. Beta-naphthoin oxime was found to be superior to alpha-benzoin oxime in selectively cocrystallizing molybdenum quantitatively from water. Detection limits were such that small amounts of molybdenum could be measured in the presence of large quantities of interfering elements. (Baker-FRC)  
W82-01098

#### AMMONIA ELECTRODE WITH IMMOBILIZED NITRIFYING BACTERIA,

Akinomoto Co., Inc., Kawasaki (Japan). Central Research Lab.  
M. Hikuma, T. Kubo, T. Yasuda, I. Karube, and S. Suzuki.

Analytical Chemistry, Vol 52, No 7, p 1020-1024, June, 1980. 7 Fig, 5 Tab, 11 Ref.

Descriptors: \*Wastewater analysis, \*Ammonia, Water analysis, Measuring instruments, Industrial wastes, Electrodes, Chemical analysis.

Nitrifying bacteria were immobilized by being entrapped between two membranes, a porous acetylcellulose membrane and the Teflon membrane of an oxygen electrode. This microbial sensor was then applied to the determination of ammonia in wastewaters. When a sample solution was pumped into the flow system of the sensor, the electrode current decreased to a steady state after 8 minutes. Measurement could be also made with a 3-minute pumping period with little loss of sensitivity. The calibration plot of the current difference vs. concentration of ammonia was linear up to 1.3 mg/liter. The sensor was applied to the determination of ammonia in wastewaters of a fermentation factory. The concentration of ammonia and the biological oxygen demand (BOD) of the sample solutions were determined by the distillation acidimetry and Japanese Industrial Standard methods, respectively. Good agreement was obtained between the ammonia concentration determined by the conventional method and that obtained by the microbial sensor. The relative difference between the two methods was less than 6%. The results were not affected by organic compounds. The

microbial sensor could be used for more than two weeks and 1400 assays. The electrode current difference decreased gradually, necessitating occasional recalibration of the electrode. (Baker-FRC)  
W82-01099

#### DETERMINATION OF NICKEL BY DIFFERENTIAL PULSE POLAROGRAPHY AT A DROPPING MERCURY ELECTRODE,

Laurentian Univ., Sudbury (Ontario). Dept. of Chemistry.

C. J. Flora, and E. Nieboer.  
Analytical Chemistry, Vol 52, No 7, p 1013-1020, June, 1980. 4 Fig, 5 Tab, 49 Ref.

Descriptors: \*Water analysis, \*Nickel, Metals, Chemical analysis, Polarographic analysis, Lakes, Drinking water, Potable water, Pollutant identification.

The use of differential pulse polarography (DPP) in the analysis of nickel was examined. The detection limit of the method of 2 ppb with a confidence interval of 95% and observed standard deviations of the same magnitude for the DMG-sensitized procedure are all comparable to those possible with modern electrothermal AA of nickel. Detection limits and precision are virtually limited by the ability to avoid contamination. The proposed DPP methods are well suited to the routine analysis of water and other aqueous samples. Especially advantageous is the flexibility to extend the analytical concentration range from ng/ml. The advent of the laboratory minicomputer should also lead to many innovations and improved performances with this method. In an analysis of Sudbury Lake and tap water, agreement between DPP and AA results are excellent for the July 7, 1978 data and somewhat less satisfactory for the data from the remaining time of experimentation. The DPP analysis requires no pretreatment of the water samples and is an extremely rapid, sensitive, reproducible, and convenient method conducting water analyses. The high contents of nickel found in Sudbury tap and lake water may be related to nickel emissions associated with local smelting and refining of the metal. (Baker-FRC)  
W82-01100

## 5B. Sources Of Pollution

#### ANTHROPOGENIC TRACE ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBON LEVELS IN SEDIMENT CORES FROM TWO LAKES IN THE ADIRONDACK ACID LAKE REGION,

Department of Energy, NY. Environmental Measurements Lab.

M. Heit, Y. Tan, C. Klusek, and J. C. Burke.  
Water, Air, and Soil Pollution, Vol 15, No 4, p 441-464, May, 1981. 2 Fig, 11 Tab, 37 Ref.

Descriptors: \*Sediments, \*Lakes, \*Pollution load, Metals, Aromatic compounds, Hydrocarbons, \*Acid rain, Acidic water, \*Adirondacks, Sagamore Lake, Woods Lake, \*New York, Sitter, Aluminum, Arsenic, Beryllium, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Tin, Vanadium, Zinc, Selenium, Thallium, Perylene.

The degree to which anthropogenic trace elements and polycyclic aromatic hydrocarbons have been deposited in remote lakes known to be affected by acid rainfall was investigated. The lakes investigated are located in the Adirondack State Park on the western slope of the Adirondack Mountains. Sagamore Lake is a brown water lake due to high levels of humic materials, while Woods Lake is generally clear. Sediment cores were taken from each of the lakes during March 1978. Several conclusions were reached. Except for perylene, the prime source of all parent PAHs measured and the majority of trace elements appears to be combustion. All combustion products had primarily an anthropogenic origin. Levels of all parent PAHs except perylene and levels of several of the metals significantly increased in the surface sediments of both lakes compared to their background concentrations. PAH concentrations in Woods Lake were quite high, approaching levels reported for more heavily

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

populated and industrialized areas. Metals were present at 3-4 times higher concentrations in Woods Lake than in Sagamore Lake. Metals and PAH levels decreased in concentration with depth to background levels in both lakes. This baseline depth corresponded to about 30 years ago. Lead has increased to the greatest extent of any of the metals considered relative to their baseline quality. Long distance atmospheric transport and region-wide deposition of anthropogenically derived elements and PAHs into these remote lakes appears to be more significant than input from local sources. (Baker-FRC)  
W82-00501

**RELATIONSHIPS BETWEEN SULFATE AND NITRATE ION CONCENTRATIONS AND RAINFALL pH FOR USE IN MODELING APPLICATIONS,**  
Battelle Pacific Northwest Lab., Richland, WA.  
Atmospheric Sciences Dept.  
D. J. McNaughton.  
Atmospheric Environment, Vol 15, No 6, p 1075-1079, 1981. 4 Fig, 2 Tab, 8 Ref.

Descriptors: \*Acid rain, \*Sulfates, \*Nitrates, Mathematical modeling, Hydrogen ion concentration, Acidity, Air pollution effects, Anions, Rainfall, Water pollution sources.

Precipitation chemistry data for the northeastern United States were analyzed to test relationships between anthropogenic sulfate and nitrate ion contributions and rainfall pH. The data set incorporated all observations, with complete measurements of all three ion concentrations being collected from September 1976 through December 1979. A relationship was found between sulfates and nitrates and rainfall acidity expressed in terms of pH, and this relationship can be applied to deposition predictions to predict pH from regional air pollutant transport models. Variance in the pH versus ion relationships can be explained by the sulfate ion concentration alone. Thus, rainfall acidity patterns could be approximated by sulfate deposition patterns alone in cases where relative levels of nitrate ions and sulfate ions in the atmosphere are the same as those that influence precipitation. The analysis was based on the assumption that the predominant anions are anthropogenic, and this assumption could lead to an overprediction of rainfall acidity. (Small-FRC)  
W82-00507

**THE BREAKDOWN OF POULTRY MANURE AGGREGATES BY RAINFALL IMPACT,**  
Science and Education Administration, Ithaca, NY.  
R. E. Muck, and D. C. Ludington.  
Journal of Environmental Quality, Vol 9, No 1, p 61-65, January-March, 1980. 6 Fig, 3 Tab, 12 Ref.

Descriptors: \*Manure, \*Rainfall impact, Rainfall rate, Land disposal, Simulated rainfall, \*Poultry, Nitrogen, Phosphorus, \*Leaching, Kinetic energy, Poultry manure.

The effects of rainfall characteristics on the breakdown of dry poultry manure aggregates were investigated, and the effects of aggregate breakdown on the leaching of N and P from poultry manure were demonstrated. Simulated rainfall was used to determine the effects of rainfall intensity, duration, drop velocity, and drop size. Aggregate breakdown was an exponential function of rainfall amount for a constant drop velocity and size. Rainfall energy and momentum both explained the aggregate breakdown results for a constant drop size. As drop size increased, aggregate breakdown seemed to increase, but these results were not statistically significant. Aggregate breakdown caused increases in the leaching of nitrogen and phosphorus from the manure. With a 4 hr, 5.08 cm/hr simulated rainfall, aggregate breakdown accounted for a 70% increase in leaching losses from the manure. Thus, the type of crop cover on which manure is spread may affect nutrient losses due to rainfall. For example, hay would intercept the rainfall before it hit the manure and thus would reduce aggregate breakdown by rainfall. (Small-FRC)  
W82-00513

**DYE-SENSITIZED PHOTOOXIDATION OF BROMACIL IN WATER,**  
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Residues Chemistry.

A. J. Achter, and S. Saltzman.  
Journal of Environmental Quality, Vol 9, No 2, p 190-194, April-June, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: \*Bromacil, \*Degradation, \*Dyes, Pesticide residues, \*Herbicides, Photodegradation, Chemical reactions, Solar radiation, Irradiation, \*Fate of pollutants.

To study its fate in aquatic systems, the herbicide bromacil (3-sec-butyl-5-bromo-6-methyl uracil) in aqueous solution (250 ppm) was exposed to direct solar radiation in the presence of dye sensitizers at appropriate pH. The herbicide rapidly and completely photodegraded via a debromination mechanism to 3-sec-butyl-2-acetyl-2-hydroxy hydantoin, the major product (97.98%), and the 5,5'-dimer of 3-sec-butyl-6-methyl uracil, a minor product (1.2%). Unidentified polar compounds were formed upon continued degradation. The most effective dye sensitizers were riboflavin (10 ppm) and methylene blue (2.5 ppm). Less effective sensitizers were rose bengal (5 ppm), humic acids (20 ppm), and chlorophyll (20 ppm). The reaction proceeded more rapidly at alkaline pH. With sensitizers and a reaction time of 30 min, no degradation occurred at less than pH 5, 10% at pH 7, 20% at pH 8, and 80% at pH 10. The effects of suspended solids, often found in natural waters, were tested. An anion exchange resin partially inhibited degradation, and bentonite strongly inhibited degradation. Under optimal conditions (effective sensitizer, high pH, no suspended solids) photooxidation to the intermediate products was complete within 1 hour. (Cassar-FRC)  
W82-00514

**ACID RAIN AT KENNEDY SPACE CENTER, FLORIDA: RECENT OBSERVATIONS,**  
University of Central Florida, Orlando. Dept. of Chemistry.  
B. C. Madsen.  
Atmospheric Environment, Vol 15, No 5, p 853-862, May, 1981. 7 Fig, 6 Tab, 15 Ref.

Descriptors: \*Acid rain, \*Kennedy Space Center, \*Florida, Rainfall, Air pollution, Fallout, Water pollution sources, Hydrochloric acid, Sulfuric acid, Nitric acid.

Precipitation samples were collected in automated samplers designed to prevent both dry deposition and evaporation. Determinations of major cation and anion concentrations were made within 10 days after sample collection. All sampling sites were on or near the Kennedy Space Center complex in Florida. In general, summertime acidity was greater than during other times of the year. Maximum free acidity was observed during July in both 1978 and 1979. The July rainfall accounted for 21 and 10% of the total amounts received during the respective years. Lowest acidities were noted in November 1977 and April 1979. No pattern was noted when rain composition from a specific month during the first year of the study was compared to the identical time in the following year. The presence of sulfate ion can be attributed primarily to non-marine sources. Monthly and annual deposition of components which will be important if changes in rain composition occur due to future SRM launches are presented. Free acidity, nitrate ion and excess sulfate ion deposition account for the present acid loading, while chloride ion deposition reflects the influence of the marine environment. Monthly weighted average chloride ion concentrations ranged from 20 to 240 micromole/liter. The chloride: sodium ion ratio was slightly lower than that present in sea water. (Baker-FRC)  
W82-00533

**AQUASOLS: THE BEHAVIOR OF SMALL PARTICLES IN AQUATIC SYSTEMS,**  
Johns Hopkins Univ., Baltimore, MD.  
For primary bibliographic entry see Field 1B.  
W82-00540

**PARTITIONING OF NO. 2 FUEL OIL IN CONTROLLED ESTUARINE ECOSYSTEMS, SEDIMENTS AND SUSPENDED PARTICULATE MATTER,**

Rhode Island Univ., Kingston. Graduate School of Oceanography.

For primary bibliographic entry see Field 2L.  
W82-00541

**TRACE ELEMENT CONCENTRATIONS OVER MIDLAKE MICHIGAN AS A FUNCTION OF METEOROLOGY AND SOURCE REGION,**  
Governors State Univ., Park Forest South, IL. Coll. of Environmental and Applied Sciences.  
H. Sievering, M. Dave, D. Doiske, and P. McCoy. Atmospheric Environment, Vol 14, No 1, p 39-53, January, 1980. 7 Fig, 12 Tab, 21 Ref.

Descriptors: \*Trace elements, \*Air pollution, \*Aerosols, Heavy metals, Metals, Lakes, \*Lake Michigan, Water pollution sources, Path of pollutants, Wind, Air-water interfaces.

Aerosol samples were collected during May-September 1977 over southern Lake Michigan. This location, 87 degrees west and 42 degrees north, is in midlake, 40 to 100 km removed from any shoreline aerosol sources. The samples were analyzed for Pb, Zn, Mn, Mo, Fe, Ti, Al, Ca, and Mg. Micro and meso-meteorological conditions were recorded. Several general conclusions were derived. Midlake metal concentration variabilities are linearly independent of wind speed and strongly and directly dependent on temperature stability of the surface layer, defined as the lowest few meters of air above the lake surface. Midlake mass concentration variability is more dependent on fine particulate aerosols with high Pb, Zn, and Mn content than on the coarse particulate fraction. Temperature stability of the surface air layer is more important than sedimentation and aerosol aging in terms of aerosol concentration variability within that layer. Midlake metal concentrations are more dependent on nearshore sources than on long range transport. The largest amount of Pb (95%), Zn and Mn (75%), and Fe (over 50%) present in the midlake atmospheric surface layer is probably anthropogenic in origin. (Cassar-FRC)  
W82-00550

**GROUNDWATER CONTAMINANT TRANSPORT WITH ADSORPTION AND ION EXCHANGE CHEMISTRY: METHOD OF CHARACTERISTICS FOR THE CASE WITHOUT DISPERSION,**

Texas Univ. at Austin. Dept. of Civil Engineering. R. J. Charbeneau.  
Water Resources Research, Vol 17, No 3, p 705-713, June, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: \*Solute transport, \*Adsorption, \*Ion exchange, \*Leaching, Ion transport, Groundwater movement, Uranium, Mining engineering, Path of pollutants, Ammonia, Organic compounds.

Contaminant transport involves not only the movement of a pollutant away from a waste disposal site or the fate of constituents in recharge water, but also site restoration problems caused by emerging technologies such as in situ leach mining for uranium and in situ gasification of lignite. This paper concerns adsorption and ion exchange reactions in the absence of dispersion. The method of characteristics is used to formulate the solution for any adsorption isotherm and an arbitrary number of exchanging cations. It is applicable to linear flow systems and to nonlinear systems along streamlines in a nonuniform field. With 2 exchanging cations the complete solution may be obtained by graphical means; when there are more than 2, a computer is required to solve the problem. The first example illustrates migration of organics using the nonlinear Freundlich isotherm for adsorption of organics on lignite. The second concerns the volume of water required to restore a uranium mining site by sweeping out residual ammonia and other contaminants. (Cassar-FRC)  
W82-00551

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

#### MODELING OF PROCESSES OF DECOMPOSITION OF ORGANIC MATTER IN BOTTOM SEDIMENTS, Akademiya Nauk UkrSSR, Kiev. Inst. Hidrobiologii.

Ya. L. Fuksman.

Water Resources (English Translation), Vol 7, No 5, p 442-450, September/October, 1980. 6 Fig, 8 Ref. Translated from Vodnye Resursy, No 5, p 118-120, September/October, 1980.

Descriptors: \*Mathematical models, \*Decomposing organic matter, \*Bottom sediments, Sediments, Organic matter, Decomposition, Mathematical equations, Mineralization, Fate of pollutants.

Although the decomposition of organic substances directly affects water quality, the mathematical description of this process is currently accomplished using rather simple models interpreting the general character of phenomena observed during the decomposition process. This paper discusses a more detailed mathematical model of biochemical processes of mineralization of organic matter with respect to bottom sediments. The systems of differential equations presented were developed on the basis of the energy balance in the heterotrophic population of bacteria. Nearly all of the parameters constants used in the model have a definite thermodynamic or physiological significance. A flow of particles of detritus is produced by the dying phytoplankton. The amount of detritus is expressed by the weight of some biogenic element in the detritus, the cycle of which in the water body is being modeled. The biomass of both aerobic and anaerobic bacteria are also phase variables in the model. Systems of differential equations for modeling anaerobic bacteria in an oxygen-free regime, anaerobic populations in the presence of oxygen, and populations of aerobic bacteria in the absence of anaerobic bacteria are presented. A model of the dynamics of an ecosystem with two populations is then developed which is composed of the model for the dynamics of the anaerobic population in the presence of oxygen and the model for the dynamics for the population of aerobes. (Carroll-FRC)

W82-0053

#### TRACE ELEMENT INPUTS FROM A COAL BURNING POWER PLANT TO ADJACENT TERRESTRIAL AND AQUATIC ENVIRONMENTS,

Savannah River Ecology Lab., Aiken, SC.

D. W. Evans, J. G. Wiener, and J. H. Horton.

Journal of the Air Pollution Control Association, Vol 30, No 5, p 567-573, May, 1980. 4 Fig, 4 Tab, 25 Ref.

Descriptors: \*Powerplants, \*Water pollution, \*Trace elements, Coal, Plumes, Coal fuel, Fallout, Air pollution, Rainfall, Fly ash.

Levels of trace elements derived from coal ash were investigated in terrestrial and aquatic samples near an 83 MW coal burning power plant. Comparisons were made between the trace elements arising through aerial deposition during 23 years prior to the installation of electrostatic precipitators and aquatic inputs from ash disposal basins after installation. A gaussian plume model was used to predict deposition patterns of 29 trace elements in coal ash around the power plant. Detectable increases were noted in Sr, As, Sb, and Be in surface soils within 3 km of the power plant. Concentrations measured in surface soils were largely consistent with the predictions. Measurements of aerial deposition of Cd, Pb, Cu, and Mn at a site 5.5 km distant were similar to those in other rural areas and indicated that little of the measured Cd, Cu, Mn, or Pb was derived from fly ash. Concentrations of 12 heavy metals in effluents from the basin receiving ash were comparable to those predicted in rainfall deposited nearest the plant. It was concluded that at other coal combustion facilities, basin disposal could be a more serious contamination threat to aquatic environments than aerial dispersal of ash. (Baker-FRC)

W82-0057

#### RESIDUES OF NONYLPHENOL IN SPRUCE FOLIAGE, FOREST SOIL, STREAM WATER

AND SEDIMENT AFTER ITS AERIAL APPLICATION, Forest Pest Management Inst., Sault Ste Marie (Ontario).

K. M. S. Sundaram, S. Szeto, R. Hindle, and D. MacLavish.

Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 403-419, 1980. 1 Fig, 3 Tab, 9 Ref.

Descriptors: \*Phenolic pesticides, \*Pesticide residues, \*Stream pollution, Insecticides, Water pollution, Spruce trees, Conifers, Trees, Forest soils, Sediments, Nonylphenol.

The residues of nonylphenol, a major component of the Matacil (aminocarb) formulation, were measured in a variety of natural features following aerial application of a mixture of this chemical and insecticide diluent 585 at a rate of 0.47 liters per hectare to a mixed coniferous forest in Ontario. Nonylphenol residues were found in water from the forest stream one hour after application of the insecticide to the forest and up to five days after application. The highest concentration, 9.1 ppb, which was detected one hour after spraying, decreased to trace levels of less than 2.0 ppb after 6 hours, indicating a half-life of about 2.5 hours. Water samples taken from a stagnant area of the stream showed concentrations of 1,100 ppb 4 hours after spraying, decreasing to 110 ppb in the next 2 hours, to 12 ppb within 24 hours, and to less than 1.0 ppb after 3 days. Dilution by water flow probably accounts for most of the rapid dissipation of nonylphenol residues in the stream water, while surface evaporation and co-distribution may also have been contributing factors. Residues in white spruce foliage decreased from 18.90 ppm 1 hour after spraying to about 11.34 ppm after 3 hours and to less than 0.20 ppm after 62 days. Analyses of forest soil samples collected after spraying resulted in no detections of residues. Trace levels of nonylphenol were found in only one sediment sample collected 4 hours after spraying. These data indicate that very little residue would be present in forest soil and that residues in foliage, stream water, and sediment would be non-persistent following application of nonylphenol at a rate equivalent to the seasonal allowable maximum. (Carroll-FRC)

W82-0059

#### ESTIMATION OF THE SALT BURDEN OF IRRIGATION DRAINAGE WATERS,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.

W. A. Jury, and P. F. Pratt.

Journal of Environmental Quality, Vol 9, No 1, p 141-146, January-March, 1980. 5 Fig, 5 Tab, 10 Ref.

Descriptors: \*Mathematical models, \*Salts, \*Irrigation water, Irrigation effects, Water pollution sources, Mathematical studies, Water analysis, Path of pollutants.

The effectiveness of several different models for the prediction of important interactions which govern the salt movement process through soil was evaluated. The three models used to predict salt concentration and mass emissions below irrigated fields included a proportional model, a steady-state model, and a dynamic model. The proportional model overestimated the salt burden for waters which tend to precipitate calcium salts and underestimated the salt burden of waters which tend to dissolve soil  $\text{CaCO}_3$ . The steady-state model predicted a greater tendency toward mineral dissolution than occurs when ion exchange is considered, but it calculated a more accurate salt balance than did the proportional model. The proportional model characterized irrigation management in terms of an average ratio of drainage volume to irrigation volume (leaching fraction, LF). When the saline irrigation water had  $\text{LF} = 0.1$ , the steady-state model mass emission prediction was 22% less and the transient model prediction was 36% less than the estimates of the proportional model. When the irrigation water was of high quality ( $\text{LF} = 0.4$ ), the predictions of the two models were 198 and 201% higher, respectively, than the predictions of the proportional model. (Small-FRC)

W82-0056

#### DISTRIBUTION OF SILVEX, 2,4-D, AND TCDD APPLIED TO TURF IN CHAMBERS AND FIELD PLOTS,

Science and Education Administration, Beltsville, MD. Pesticide Degradation Lab.

R. G. Nash, and M. L. Beall, Jr.

Journal of Agricultural and Food Chemistry, Vol 28, No 3, p 614-623, May/June, 1980. 3 Fig, 10 Tab, 18 Ref.

Descriptors: \*Leachates, \*Organic compounds, Leaching, Infiltration, Percolation, \*Path of pollutants, \*Agricultural chemicals, Pesticides, Herbicides, Silvex, 2,4-D, Dioxins, TCDD, Residues, Water pollution.

The fate of 2,4-D, silvex, and TCDD applied to bluegrass turf was examined in four components, soil, grass, water, and air, of microagroecosystem chambers. Concentrations employed were as follows: 1.3 kg of granular 2,4-D per hectare, 2.8 kg granular and 2.0 kg emulsifiable silvex per hectare. A high-activity radiolabeled preparation of the possible toxic trace contaminant of silvex, TCDD, was added. Residue half-times for silvex on soil were 35 days for both formulations and 10 days for granular 2,4-D. TCDD concentrations in leachate water were less than 10 to the minus 16th power and 10 to the minus 13th power g/g water after silvex applications containing 44 ppb and 7.5 ppm TCDD, respectively. Silvex and 2,4-D concentrations were in the microgram/liter range as leachates and decreased with time. TCDD concentrations were less than 0.1 pg/liter. The TCDD concentration in the leachate seemed to increase with time, peaked on day 126, and then decreased to less than 10 pg/liter by day 275. The half-life values for leachate water, with high correlation coefficients, were about 10 days for both formulations of silvex and 6.5 days for the granular 2,4-D. After day 126, the half-life values for TCDD were 65 and 57 days for the emulsifiable concentrate and granular formulations, respectively. (Baker-FRC)

W82-0058

#### RESIDUES OF ISOBORNYL THIOCYANOACETATE (THANITE) AND A METABOLITE IN FISH AND TREATED PONDS,

National Fishery Research Lab., La Crosse, WI. J. L. Allen, J. B. Sills, V. K. Dawson, and R. T. Amel.

Journal of Agricultural and Food Chemistry, Vol 29, No 3, p 634-636, 1981. 3 Tab, 9 Ref.

Descriptors: \*Ponds, \*Fish, \*Insecticides, Carp, Bass, Metabolites, Sublethal effects, Thanite, Pesticide residues, Fate of pollutants.

The insecticide isobornyl thiocyanoacetate (Thanite) induces a surfacing response in fish, which may permit live collection of fish. However, there are no data on residues of the insecticide in fish exposed to the chemical nor on the persistence of Thanite in the aquatic environment. Only a trace of the parent compound was found in carp and largemouth bass exposed to Thanite at 1 mg/liter in the laboratory. A metabolite, isobornyl alpha-(methylthio)-acetate, was isolated and identified by gas chromatography-mass spectroscopy, and a reference standard for the metabolite was synthesized. Residues of the metabolite were found in the muscle tissue of largemouth bass and in the muscle tissue, blood plasma, and bile of carp within one hour after exposure to Thanite. Residues of the metabolite decreased to undetectable levels within 24 hours of withdrawal from water containing Thanite for the bass and within 48 hours for the carp. Residues of Thanite were detectable in water and soil samples from experimental ponds up to 14 days after treatment at 0.4 mg/liter, but not at 21 days after treatment, while algae samples contained detectable levels of Thanite in the 21-day samples but not at 28 days. The metabolite found in the bass and carp was not found in samples of water, soil, or algae. The results demonstrate that Thanite is rapidly metabolized and eliminated by fish and does not persist in a pond environment beyond 3 weeks. (Carroll-FRC)

W82-0057

#### WATER-TO-AIR FRACTIONATION OF BACTERIA,

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

Florida State Univ., Tallahassee. Oceanography Dept.  
T. W. Hejkal, P. A. LaRock, and J. W. Winchester.

Applied and Environmental Microbiology, Vol 39, No 2, p 335-338, February, 1980. 4 Fig, 17 Ref.

Descriptors: \*Bacteria, \*Air-water interfaces, Interfaces, Escherichia coli, Serratia marinorubra, Micrococcus eurhalis, Pseudomonas bathycetes, Bacillus subtilis, Water treatment facilities, Wastewater treatment, Spray irrigation, Human disease, \*Path of pollutants.

An attempt was made to determine the quantitative differences among several bacterial species in their abilities to be ejected into the atmosphere by bubbles rising through water and bursting at the air-water interface. Three species of marine bacteria, Serratia marinorubra, Pseudomonas bathycetes, and Micrococcus eurhalis, were tested for their ability to be aerosolized. Bubbles were generated in suspensions of mixed bacterial cultures, and the concentration was measured for each species in the top jet drop ejected. This concentration, divided by the concentration in the bulk menstruum, is the concentration factor (CF). Bubbles were generated 2 cm below the liquid surface, and jet drops with diameters from 34 to 136 micrometers were studied. *S. marinorubra* and *M. eurhalis* had CFs which were generally 10 to 100 times greater than those of *Escherichia coli*, *P. bathycetes*, and spores of *Bacillus subtilis*. *P. bathycetes* never had a CF significantly greater than 1 at any drop size, and spores of *B. subtilis* had a maximum CF of 4. *E. coli* had a maximum CF of 6 to 1- or 2-day old cultures, but this increased to 80 when a 5 day old culture was used. This change in the CF with age of the cells indicates that composition of the cell may be a factor influencing its ability to concentrate in jet drops. (Baker-FRC)

W82-00575

UTILIZATION OF DICHLOROMETHANE BY SUSPENDED AND FIXED-FILM BACTERIA, Stanford Univ., CA. Dept. of Civil Engineering, B. E. Rittmann, and P. L. McCarty.

Applied and Environmental Microbiology, Vol 39, No 6, p 1225-1226, June, 1980. 2 Fig, 8 Ref.

Descriptors: \*Bacteria, \*Effluents, \*Dichloromethane, Biodegradation, Industrial wastes, Wastewater, Growth, Organic compounds, Fate of pollutants.

The biodegradation of dichloromethane, a commonly used solvent ubiquitous in aqueous environments, is described and evidence that the chemical will support bacterial growth is offered. Bacterial cultures were enriched from a seed of primary sewage effluent over a 12 month period. Several enrichment cultures, having different bacterial densities, were developed. It was noted that culture turbidity changes and dichloromethane utilization were not significant if bicarbonate was omitted from the mineral medium. The enriched bacteria were predominantly gram-negative, motile rods. Batch, suspended-growth and biofilm experiments were performed to demonstrate dichloromethane utilization. The biological utilization of dichloromethane at 1-25 mg/liter by suspended bacteria was readily apparent. Since neither carbon dioxide evolution nor intermediates were measured, it was not possible to state whether dichloromethane was completely mineralized or by what pathway it was metabolized. Even so the study shows that dichloromethane can be used as an energy source without serving as a cometabolite. Although not conclusive, the fact that suspended growth was reduced when bicarbonate was omitted from the mineral medium suggest that the autotrophic pathway was used. (Baker-FRC)

W82-00577

MICROBIAL METABOLISM OF N-NITROSODIETHANOLAMINE IN LAKE WATER AND SEWAGE, Cornell Univ., Ithaca, NY. Soil Microbiology Lab. For primary bibliographic entry see Field 2H. W82-00585

MOVEMENT OF ENDOTOXIN THROUGH SOIL COLUMNS, Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.

S. M. Goyal, C. P. Gerba, and J. C. Lance. Applied and Environmental Microbiology, Vol 39, No 3, p 544-547, March, 1980. 1 Fig, 2 Tab, 18 Ref.

Descriptors: \*Endotoxin, \*Groundwater pollution, Rainfall, Percolation, \*Land disposal, \*Bacteria, Wastewater disposal, Waste disposal, Adsorption, Toxins, Soil contamination.

The possible removal of endotoxin during land treatment and the chance that endotoxin can reach groundwater after land application of wastewater were investigated. The movement of endotoxin through soil columns was studied under laboratory conditions. A 10 cm diameter polyvinyl chloride pipe was packed with loamy sand from the dry Salt River bed located near Phoenix, Arizona. Either 100 or 250-cm long soil columns were employed. While it was determined that endotoxin is removed by the soil, it was noted that endotoxin-containing sewage must travel longer distances than virus-containing sewage before any appreciable removal occurs. Free endotoxin is refractory to adsorption by granulated activated-carbon columns, whereas 83% of bound endotoxin is removed by passage through two granulated activated-carbon columns in series. Thus, there is a potential for some endotoxin contamination of groundwater if the aquifer is shallow. When a simulated rainfall was applied to the columns in which the endotoxin had been adsorbed, the endotoxin concentration moved through the soil as a concentrated band. Thus it appears that rainwater can desorb endotoxin from soil and that travel of endotoxin to groundwater is a distinct possibility. In field studies two land treatment sites were sampled to compare the amount of endotoxin in the sewage being applied and that present in groundwater samples. At Lubbock, Texas, 600 to 6000 ng of endotoxin per ml was found in the sewage, and 0.6 to 480 ng/ml in the groundwater. At Fort Devens, 300 ng of endotoxin per ml was in the sewage, and 0.3 to 30 ng/ml in the groundwater. (Baker-FRC)

W82-00586

DYNAMICS OF SELENIUM IN MERCURY-CONTAMINATED EXPERIMENTAL FRESH-WATER ECOSYSTEMS, Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

J. W. M. Rudd, M. A. Turner, B. E. Townsend, A. Swick, and A. Furutani. Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 848-857, May, 1980. 8 Fig, 3 Tab, 32 Ref.

Descriptors: \*Path of pollutants, \*Aquatic animals, \*Ecosystems, \*Selenitum, \*Mercury, Bioaccumulation, Fate of pollutants, Herbicides, Fish toxins, Heavy metals, Water pollution effects, Water pollution sources, Lakes, Sulphate, Benthos, Crayfish, Bottom sediments.

The movement of selenium (Se) and mercury (Hg) through experimental aquatic ecosystems in a lake contaminated with mercury (Hg) was studied. Stable Se or sulfate water concentrations were increased while aquatic herbicides (Velpar or terbutryne) were added to the model system. Part of the water column was isolated from contact with the sediments. Radioactively labeled Se and Hg did not move simultaneously through the ecosystem either geochemically or biologically. Se was rapidly bioaccumulated in fish, crayfish, and haptobenthos, an effect which was enhanced by increased sulfate levels in the absence of exposure to bottom sediments and decreased by aquatic herbicides. Se levels of 0.1 mg/l did not affect Hg movement out of the water column, but stabilized Hg movement among different compartments of the water column. Hg bioaccumulation by fish, crayfish and haptobenthos was inhibited by elevated Se levels. Se toxicity to several aquatic species was investigated. The possible use of Se as an ameliorating agent for freshwater systems polluted by heavy metals is considered. (Geiger-FRC)

W82-00595

Biodegradability of halogen-substituted diphenylmethanes, Monsanto Co., St. Louis, MO.

V. W. Saeger, and Q. E. Thompson. Environmental Science and Technology, Vol 14, No 6, p 705-709, June, 1980. 2 Tab, 18 Ref.

Descriptors: \*Biodegradation, \*Organic compounds, Molecular structure, Hydrocarbons, Halogens, Diphenylmethanes, Activated sludge, River water, Microorganisms, Rivers.

Primary and ultimate biodegradation test procedures were used to determine the biodegradability of 32 halogenated diphenylmethanes exposed to activated sludge and river water microorganisms. Generally, diphenylmethanes having one unsubstituted phenyl ring exhibited high primary degradation rates. Those substituted on both rings were slow to degrade. Ultimate biodegradation measurements on materials with high primary degradation rates indicate that the cleavage rate of the second phenyl ring decreases, in general, with increasing levels of substitution on the ring. The data point out, however, the inherent difficulties in predicting whether a specific synthetic molecule will be biodegradable. In keeping with other facets of biological behavior, minor changes in structure can lead to drastic changes in biodegradability. (Baker-FRC)

W82-00599

THE NONFUEL MINERALS INDUSTRY: REGULATORY IMPACTS, Mire Corp., McLean, VA. METREK Div. A. Hershaft, and W. Lacy.

Environmental Science and Technology, Vol 14, No 4, p 404-408, 410-412, April, 1980. 6 Tab.

Descriptors: \*Mineral industry, \*Metal-finishing wastes, Metallurgy, Industrial plants, Industrial wastes, Effluents, Mine wastes, Mine drainage, Drainage, Water quality, Regulations, Standards.

Water pollutants are generated at every step of metal mining and processing. Runoff from exposed ore bodies and overburden and tailing piles carries suspended solids, acid sulfate, heavy metals, and other dissolved salts. Some of these pollutants find their way into the groundwater. The slurry contains additional suspended solids, as well as chemicals used in the ore concentration process. Smelting and refining effluents contain heavy metals and other substances, sometimes ammonia, cyanides, nitrates, oil and grease, and phenols introduced with coke, as well as fluorides added as a fluxing agent. Runoff can be minimized and directed to tailing ponds or containment lagoons. Percolation to the groundwater can be controlled by lining the bottom of the pond with clay, paving material, or an impermeable plastic or rubber membrane. Public concern has generated laws in recent years to assist in the management of mining and processing wastes. Pollution from these operations can adversely affect eight types of water uses: municipal supply, industrial supply, agricultural supply, commercial fishing, wildlife preservation, recreation, navigation, and aesthetic enjoyment. Assessing the benefits to these water uses derived from the regulatory statements issued by the federal and state governments is difficult. However, there is impressive evidence of water quality improvement attributable to pollution control regulations. (Baker-FRC)

W82-00612

COAL TAR COATINGS OF STORAGE TANKS, A SOURCE OF CONTAMINATION OF THE POTABLE WATER SUPPLY, New York State Dept. of Health, Albany. Div. of Lab. and Research.

K. Alben.

Environmental Science and Technology, Vol 14, No 4, p 468-470, April, 1980. 1 Fig, 3 Tab, 10 Ref.

Descriptors: \*Storage tanks, \*Coatings, Linings, Leaching, Leachates, Water storage, Water tanks, Storage, Hydrocarbons, Water quality, Water pollution sources, \*Coal tar coatings, Health hazards.

Fourty-liter field samples were collected in duplicate at the inlet and outlet of a 12,000 gallon

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

storage tank which had been given an interior coating of coal tar five years earlier. Similarly, 40-liter laboratory samples were prepared from tap water exposed to test panels coated with the same coal tar as used on the storage tank. Results obtained from GC-MS analysis of the storage tank samples indicated that concentrations of specific polycyclic aromatic hydrocarbons increased 5 to 30 times over the concentrations of the same chemicals found in the influent to the tanks. Concentrations in micrograms/liter in the influent and effluent respectively for the following compounds were: naphthalene, 0.004 and 0.025; fluorene, 0.001 and 0.021; phenanthrene + anthracene, 0.019 and 0.210; fluoranthene, 0.003 and 0.081; and pyrene 0.002 and 0.071. It was concluded that polycyclic aromatic hydrocarbons can leach from commercial coal tar coatings of storage tanks into the water supply. One of the compounds, fluoranthene, is among the six polycyclic aromatic hydrocarbons designated by the World Health Organization as possessing a health hazard when drinking water is contaminated with it. The levels of each of the chemicals detected are considered to be significant. (Baker-FRC)

W82-00616

#### AROMATIC AMINES IN AND NEAR THE BUFFALO RIVER, Indiana Univ. at Bloomington. School of Public and Environmental Affairs.

C. R. Nelson, and R. A. Hites.  
Environmental Science and Technology, Vol 14,  
No 9, p 1147-1149, 1980. 3 Fig, 2 Tab, 7 Ref.

Descriptors: \*Dye industry wastes, \*Water pollution sources, Industrial wastes, Rivers, \*Buffalo River, Fish, Fish diseases, Leaching. New York.

The identification of the 2-propanol-extractable, basic organic compounds present in soil and river sediment obtained near a dye manufacturing plant is described. The environmental implications of this identification are discussed. Sediment samples were collected in midchannel by an Eckman dredge during June of 1979. Soil samples were collected in 1978. The following aromatic amines were found in the sediment samples from the Buffalo River: 4,4'-bis(dimethylamino)biphenyl, 4-(dimethylamino)benzophenone, bis(4-dimethylaminophenyl)methane, bis(4-dimethylaminophenyl)phenylmethane, 1-naphthylamine, and N-ethyl-N-phenylbenzylamine. Most of the compounds detected are either starting materials, intermediates, byproducts, or products associated with the commercial synthesis of two dyes: malachite green and crystal violet. The remaining compounds were either other products of the dyestuff plant or common industrial chemicals. The findings of so many chemicals in the soil samples suggests that the site was used as a chemical dump by the dyestuff manufacturer, and it is further suggested that the chemicals entered the Buffalo River by leaching from the dump site. Fish in the river have been exposed to these compounds by direct contact with contaminated sediment, and their numerous tumors may have resulted from this exposure. (Baker-FRC)

W82-00622

#### GROUNDWATER LEACHING OF ORGANIC POLLUTANTS FROM IN SITU RETORTED OIL SHALE. A MASS TRANSFER ANALYSIS, California Univ., Berkeley. Dept. of Civil Engineering.

G. L. Amy, A. L. Hines, J. F. Thomas, and R. E. Selleck.

Environmental Science and Technology, Vol 14,  
No 7, p 831-835, July, 1980. 4 Fig, 2 Tab, 18 Ref.

Descriptors: \*Groundwater, \*Leaching, \*Oil shale, Groundwater pollution, Organic compounds, Mass transfer, Diffusion coefficient.

A mass transfer analysis of laboratory data was conducted to evaluate the potential degradation of groundwater quality by organic pollutants leached from in situ retorted oil shale. Two unique samples of in situ retorted oil shale were investigated in a series of laboratory experiments. Results of the experiments were subjected to a mass transfer anal-

ysis to determine the rate-limiting step involved in the leaching of organic pollutants by groundwater. This mass transfer analysis suggested that, for one of the samples, internal diffusion through the porous infrastructure of retorted oil shale particles is the rate controlling mass transfer step. For the other sample, no single rate controlling step was conclusively identified, although it appeared that internal diffusion was important in the overall leaching phenomenon. Since internal diffusion is an extremely slow mass transfer process, it is anticipated that low, relatively constant levels of organic pollutants will appear in groundwater and persist for long periods of time. This implies that there may be a chronic, long-term groundwater pollution problem in areas of future in situ oil shale development. (Baker-FRC)

W82-00626

#### TRACE METAL CATALYSIS IN AQUATIC ENVIRONMENTS,

California Inst. of Tech., Pasadena. W. M. Keck Labs.

M. R. Hoffman.  
Environmental Science and Technology, Vol 14,  
No 9, p 1061-1066, September, 1980. 4 Fig, 1 Tab,  
52 Ref.

Descriptors: \*Catalysts, \*Trace metals, \*Water pollution control, \*Chemical reactions, Heavy metals, Aquatic environment, Oxidation, Reduction, Sulfur compounds, Suspended matter.

The possible roles that trace metals may play in the catalysis of aquatic reactions are explored, and the kinetic and mechanistic aspects of hydrolysis, redox, and autoxidation reactions are explained. The applicability of certain catalytic reactions for pollution control is considered. It is noted that transition metals and associated complexes may prove useful from a commercial standpoint for improved pollution control systems. The catalyzed autoxidation of hydrogen sulfide and sulfur dioxide and other reduced sulfur compounds in the presence of homogeneous or heterogeneous organometallic complexes may provide convenient and economical methods for sulfur pollution control. The principal products of the metal phthalocyanine-catalyzed autoxidation of hydrogen sulfide and mercaptans in sour refinery distillates are reported to be colloidal sulfur, polythionates, and sulfate. Conceivably, similar catalytic systems could be used for the autoxidation of selected organic pollutants for industrial wastewater treatment. (Baker-FRC)

W82-00629

#### KEPONE IN THE JAMES RIVER, Virginia Inst. of Marine Sciences, Gloucester Point.

R. J. Huggett, and M. E. Bender.  
Environmental Science and Technology, Vol 14,  
No 8, p 918-923, August, 1980. 3 Fig, 3 Tab, 16 Ref.

Descriptors: \*Rivers, \*Pesticides, \*Kepone, \*James River, \*Virginia, \*Chesapeake Bay, Sediments, Bottom sediments, Surface water, Benthic environment, Toxicity, Sediment transport, Fish, Oysters, Mollusks.

The major source of Kepone contamination in Virginia was the manufacturing plants at Hopewell. However, the compound is also generated in the production and degradation of Mirex, and many environmental samples outside of this area of Virginia also record the presence of kepone. In the Chesapeake Bay, moving northward from the James River, most marine species exhibit a significant decline in kepone concentrations. Residues in bottom feeders decline very rapidly, reflecting a decrease in contamination of the immobile food supplies. Piscivorous species showed slower rates of decontamination, possibly because their primary food sources were mobile and transported kepone residues to greater distances. Bluefish showed less of a decline in contamination than any other finfish, as these are highly mobile and move in and out of the James to other areas of the bay. The bottom sediments of the James have acted to some degree as a reservoir for kepone. From the bottom

it cycles to solution and is taken up by plants and animals, to be returned eventually to the sediments on death of the organisms. Benthic animals may take up kepone directly and transfer it to their predators. Evidence from 1979 suggests that surface sediments are demonstrating lessening levels of contamination. It is noted, however, that a major hurricane, which has not hit this area since the 1950s, could stir up the bottom and redistribute the sediments overnight, possibly even moving the contamination into the Chesapeake Bay. (Baker-FRC)

W82-00631

#### TRACE ELEMENT ACCUMULATION, MOVEMENT, AND DISTRIBUTION IN THE SOIL PROFILE FROM MASSIVE APPLICATIONS OF SEWAGE SLUDGE,

California Univ., Berkeley. Dept. of Soils and Plant Nutrition.

For primary bibliographic entry see Field 5E.

W82-00640

#### INFLUENCE OF GASEOUS NITRIC ACID ON SULFATE PRODUCTION AND ACIDITY IN RAIN,

Environmental Sciences Research Lab., Research Triangle Park, NC.

J. L. Durham, J. H. Overton, and V. P. Aneja.  
Atmospheric Environment, Vol 15, No 6, p 1059-1068, 1981. 4 Fig, 3 Tab, 33 Ref.

Descriptors: \*Acid rain, \*Mathematical models, \*Nitric acid, Acidity, Hydrogen ion concentration, Air pollution effects, Sulfates, Simulated rainfall.

A physico-chemical subcloud rain model was used to study the pollutant chemistry leading to rain acidification. In the model, drops fall through a polluted region containing trace gases CO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub>, HNO<sub>3</sub>, NO, and NO<sub>2</sub>. The concentration of each chemical species within a drop was calculated. Subcloud scavenging of HNO<sub>3</sub> may control acidification during the beginning of a rain event and may have more control over the final pH than SO<sub>2</sub>. In fact, gaseous HNO<sub>3</sub> inhibits the production of sulfate in rain by lowering the pH. Acidification was not caused by the oxides of nitrogen, NO and NO<sub>2</sub>. In-cloud scavenging can have greater control over final acidity than subcloud scavenging. Furthermore, gaseous HNO<sub>3</sub> is removed from the atmosphere more rapidly than SO<sub>2</sub> or O<sub>3</sub>. In this simulation, cumulative NO<sub>3</sub> decreased by 42% in one hour, while SO<sub>4</sub> and pH slightly increased. This theoretical study did not consider the formation of rain in the polluted zone, and the effect of in-cloud processes are ignored. (Small-FRC)

W82-00642

#### ACID PRECIPITATION: THE IMPORTANCE OF NITRIC ACID,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

For primary bibliographic entry see Field 2K.

W82-00643

#### THE ORGANIC POLLUTION OF RIVER CUBILLAS (GRANADA, SOUTH SPAIN),

Granada Univ. (Spain). Dept. of Ecology.

J. C. Canteras.

Acta Hydrobiologica, Vol 22, No 4, p 439-448, 1980. 3 Fig, 1 Tab, 6 Ref.

Descriptors: \*Organic matter, \*Low flow, \*Rivers, Water pollution sources, Industrial waste, River flow, Bacteria, Chemical properties, Cubillas River, \*Spain.

The pollution of the River Cubillas is investigated with emphasis on the relationship between the heterotrophic bacterial population and various chemical factors which are affected by the organic matter draining from stored olives at oil mills. The river was sampled at six locations, and the following parameters were determined: oxygen, nitrates and nitrites, total alkalinity, and phosphates. The slide sprinkling technique was used to determine the heterotrophic bacterial population. The

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

number of correlations between variables increased with the degree of pollution. The oil mill located between the first and second sampling stations did not greatly affect the river. The repeated addition of wastes along the river from several mills is the source of the problem because of the river's low flow with no possibility of self-purification between one mill and the next. (Small-FRC)  
W82-00674

#### PERSISTENCE AND DISTRIBUTION OF ERYSPHELOTHRIX RHUSIOPATHIAE AND BACTERIAL INDICATOR ORGANISMS ON LAND USED FOR DISPOSAL OF PIGGERY EFFLUENT,

Victoria Dept. of Agriculture (Australia).  
Attwood Veterinary Research Lab.  
D. S. Chandler, and J. A. Craven.  
Journal of Applied Bacteriology, Vol 48, No 3, p 367-375, June, 1980. 3 Tab, 16 Ref.

Descriptors: \*Animal wastes, \*Land disposal, \*Animal diseases, Waste disposal, Bacteria, Bioindicators, Environmental effects, Agriculture, Victoria, \*Australia.

Effluent was sampled from 35 Victorian commercial piggeries and tested for the presence of *Erysipelothrix rhusiopathiae*, the cause of swine erysipelas. Also, the survival of the organism in soil and pasture used for the disposal of untreated piggy waste was determined. The organism was isolated from 15 of the 40 samples. It was found at disposal sites for up to two weeks after application of effluent. It was more common in soil than pasture. The survival of bacterial indicator organisms was determined and fecal coliforms in top soil survived 8 to 19 days and 5 to 12 days on pasture. Fecal streptococci survived 10 to 14 days in soil and 8 to 11 days on pasture. Laboratory studies indicated that the death rate of *Erysipelothrix rhusiopathiae* was six times greater than *E. coli* in soil at field capacity. Animals grazing on effluent disposal sites would be more likely to ingest *E. rhusiopathiae* from fecal material and topsoils of disposal sites than from pasture material. The fast decay rate means the risk of infection would be low by the time a hundred- or thousand fold reduction in *E. coli* or fecal coliform numbers occurred. (Small-FRC)  
W82-00686

#### 1980 ANNUAL REPORT - A PERSPECTIVE ON THE PROBLEM OF HAZARDOUS SUBSTANCES IN THE GREAT LAKES BASIN ECOSYSTEM,

International Joint Commission—United States and Canada, Windsor (Ontario).  
For primary bibliographic entry see Field 5C.  
W82-00707

#### ASSESSMENT OF AIRBORNE ORGANIC CONTAMINANTS IN THE GREAT LAKES ECOSYSTEM,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.  
J. J. Eisenreich, B. B. Looney, and J. D. Thornton.  
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem. Appendix A, November, 1980. 150 p. 36 Tab, 199 Ref. International Joint Commission, Windsor, Ontario.

Descriptors: \*Lakes, \*Organic wastes, \*Precipitation, \*Organic compounds, \*Water pollution sources, \*Air pollution effects, Organic pesticides, Air pollution, Lake sediments, Acid rain, Chemical precipitation, Chlorinated hydrocarbons, Hydrocarbons, Water-sediment interfaces, \*Great Lakes basin, Ecosystems.

No systematic survey of the identity, concentrations and frequency of occurrence of true organics has been performed in the Great Lakes Basin ecosystem; however, a review of literature and past research was conducted for both dry and wet deposition to assess current needs regarding the identification and control of organic airborne contaminants. Atmospheric deposition was found to be greater for Lakes Superior, Michigan, and Huron

than for Lakes Erie and Ontario, as a result of general mass air circulation patterns, a large lake/basin area, and higher atmospheric concentrations. While atmospheric deposition of airborne PCBs is the most serious known toxic organic problem affecting Great Lakes water quality, other trace organics for which the atmospheric pathway is important include DDT and group pesticides, aliphatic hydrocarbons, methoxychlor, PAHs, and phthalate esters. The report recommends that a study be made of land-based sampling vs. over-lake sampling, the sources of airborne trace organics, and the transport of organics from urban areas to the lakes. In addition, the atmospheric pathway for the input of trace organics should be compared to other input pathways including tributary inflow, municipal and industrial discharges, and erosion. (Garrison-Omniplan)  
W82-00709

#### ASSESSMENT OF AIRBORNE INORGANIC CONTAMINANTS IN THE GREAT LAKES,

Illinois Inst. of Tech., Chicago. Prizer Dept. of Environmental Engineering.  
H. E. Allen, and M. A. Halley.  
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix B, November, 1980. 160 p. 19 Fig, 22 Tab, 63 Ref, 5 Append. International Joint Commission, Windsor, Ontario.

Descriptors: \*Lakes, \*Water pollution sources, \*Precipitation, \*Heavy metals, \*Air pollution effects, \*Chemical precipitation, Trace metals, Air pollution, Acid rain, Water-sediment interfaces, Lake sediments, Data interpretation, On-site data collections, \*Great Lakes.

Many studies of the atmospheric deposition of inorganic contaminants in the Great Lakes area have been conducted to determine the ecological and geochemical significance of such constituents as nitrate, phosphates, aluminum, cadmium, chromium, copper, iron, manganese, lead, and nickel. This report reviews these studies and concludes that true loading to the Great Lakes may never be fully known. Efforts to increase knowledge of atmospheric deposition should include consideration of sampling sites that (1) represent a relatively large area; (2) consider the optimum above-ground or ground-level height for collectors; (3) include an adequate snow collection method; (4) include rural and urban sites for any loading estimate of local point sources; (5) use wet and dry samplers; and (6) involve coordination between Canadian and U.S. monitoring efforts. It is important that data studies consider the impact and measurement of contaminated samples and the risk of sample evaporation. The report recommends that a joint monitoring network be established between the U.S. Environmental Protection Agency and the Canada Centre for Inland Waters. (Garrison-Omniplan)  
W82-00710

#### SOURCES AND CONTROL OF ORGANIC AIR POLLUTANTS,

Ontario Ministry of the Environment, Toronto (Ontario).

R. B. Canton, and E. T. Barrow.  
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix C, November, 1980. 10 p. International Joint Commission, Windsor, Ontario.

Descriptors: \*Chemical precipitation, \*Air pollution effects, \*Air pollution, \*Chemical degradation, \*Precipitation, Acid rain, Organic compounds, Catalysts, Electro-phoresis, Incineration, Waste disposal, Oxidation.

Total organic air emissions in 1978 for North America were estimated at 33 million tons, of which 38% derived from power sources used in the transportation industry and 27% were from organic solvents, such as paints, and dry cleaning and degreasing processes. This report reviews the complex issue of organic pollution sources and the available technologies for the degradation of organic pollutants. The conclusion is drawn that in

most instances, current technology is capable of reducing discharges to tolerable levels. Each approach to reducing emissions—recycling, reducing quantities emitted, and reducing effects of emissions—presents technical problems. Specific reduction methods include electrostatic precipitation, chemical processes, control of ducted particulate or droplet material, control of ducted vapors, control of fugitive emissions, condensation, and incineration. The development of poison-resistant catalysts, and ceramic supports for the catalysts, has improved the capability of catalytic oxidation at temperatures well below those required for thermal oxidation of organics. It is in the use of the so-called phoretic effects—electrophoresis, diffusophoresis, and thermophoresis—that the development of scrubber technologies has progressed most. (Garrison-Omniplan)  
W82-00711

#### PROPOSED WATER QUALITY CONTROL PLAN FOR INDIJO SUBAREA OF THE WHITEWATER HYDROLOGIC UNIT, WEST COLORADO RIVER BASIN.

California Regional Water Quality Control Board, Palm Desert, Colorado River Basin Region.  
For primary bibliographic entry see Field 6F.  
W82-00716

#### HYDROGEOCHEMISTRY AND SIMULATED SOLUTE TRANSPORT, PICEANCE BASIN, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.  
S. G. Robson, and G. J. Saulnier Jr.  
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, \$4.25. Geological Survey Professional Paper 1196, 1981. 65 p, 45 Fig, 4 Tab, 64 Ref.

Descriptors: \*Geochemistry, \*Groundwater, \*Oil shale, \*Mine drainage, Model studies, Aquifer characteristics, Water quality, Water pollution sources, Surface-groundwater relations, \*Colorado, Piceance basin, Solute-transport modeling.

Oil-shale mining activities in Piceance basin in northwestern Colorado could adversely affect the ground- and surface-water quality in the basin. This study of the hydrology and geochemistry of the area used ground-water solute-transport-modelling techniques to investigate the possible impact of the mines on water quality. Maps of the extent and structure of the aquifer were prepared and show that a saturated thickness of 2,000 feet occurs in the northeast part of the basin. Ground-water recharge in the upland areas in the east, south, and west parts of the basin moves down into deeper zones in the aquifer and laterally to the discharge areas along Piceance and Yellow Creeks. The saline zone and the unsaturated zone provide the majority of the dissolved solids found in the ground water. Precipitation, ion-exchange, and oxidation-reduction reactions are also occurring in the aquifer. Model simulations of ground-water pumping in tracts C-a and C-b indicate that the altered direction of ground-water movement near the pumped mines will cause an improvement in ground-water quality near the mines and a degradation of water quality downgradient from the tracts. Model simulations of mine leaching in tract C-a and C-b indicate that equal rates of mine leaching in the tracts will produce much different effects on the water quality in the basin. Tract C-a, by virtue of its remote location from perennial streams, will primarily degrade the ground-water quality over a large area to the northeast of the tract. Tract C-b, by contrast, will primarily degrade the surface-water quality in Piceance Creek, with only localized effects on the ground-water quality. (USGS)  
W82-00723

#### TEMPERATURE AND SOLUTE-TRANSPORT SIMULATION IN STREAMFLOW USING A LAGRANGIAN REFERENCE FRAME,

Geological Survey, NSTL Station, MS. Water Resources Div.

For primary bibliographic entry see Field 2E.  
W82-00726

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

METAL LEACHING FROM SEWAGE SLUDGE ASH,  
Connecticut Univ., Storrs. Dept. of Chemical Engineering.  
H. E. Klei, D. Sundstrom, and C. Sweeney.  
*BioCycle*, Vol. 22, No 3, p 41-43, May/June, 1981.  
4 Fig, 3 Tab, 6 Ref.

Descriptors: \*Metals, \*Leaching, \*Sludge ash, Acid rain, Heavy metals, Ash, Water pollution sources, Fate of pollutants, Incineration, Copper, Chromium, Cobalt, Calcium, Iron, Magnesium, Manganese, Lead, Nickel, Potassium, Sodium, Sludge disposal.

Column elution and batch leaching tests, conducted on unquenched incinerator ash from a wastewater plant, recovered varying amounts of metals using water of pH 5.3 and 4.0. No cobalt, iron, or lead was recovered in the leachates. Water at pH 4.0, simulating acid rain, eluted 27% of the Cu, 79% of Cr, 40% Ca, 28% Mg, 25% Mn, 11% Ni, 20% K, and 21% Na after a single batch extraction. From 0 to 3.76% metals were leached during column elution tests using 6 bed volumes of liquid. Water of pH 5.3 recovered half to 75% of these amounts. If ash is extracted with water before sending it to the landfill, an appreciable fraction of the Ca and Cr may be recovered. (Cassar-FRC)  
W82-00770

TRANSFORMATIONS OF NITROGEN IN A POLLUTED ESTUARY: NONLINEARITIES IN THE DEMAND FOR OXYGEN AT LOW FLOW, Harvard Univ., Cambridge, MA. Center for Earth and Planetary Physics.

S. C. Wofsy, M. B. McElroy, and J. W. Elkins. *Science*, Vol 213, No 4509, p 754-757, August 14, 1981. 2 Fig, 16 Ref.

Descriptors: \*Ammonium, \*Oxygen demand, \*Nitification, \*Low Flow, Fate of pollutants, Sewage bacteria, Oxidation, \*Potomac River, Delaware River, \*Estuaries, Nitrogen cycle, Model studies, Bacteria, Nitrites, Chemical reactions.

A simple kinetic model was developed to describe the oxidation of sewage ammonium in the Potomac River. Growth of nitrifying bacteria is limited by the supply of ammonium ion, supplied at a constant rate of 200 g N per sec. The oxidation rate varies inversely with fresh water inflow, and the oxygen demand varies as the inverse square of the fresh water inflow rate. The model accounts for observed concentrations of ammonium and nitrous oxide except at stream flows less than 80 cu meters per sec (usual range 20-250 cu meters per sec, mean 130 cu meters per sec). At low flow, peculiar behavior of maximum ammonium concentrations is seen. Peak concentrations increase as flow declines from 200 to 100 cu meters per sec, but decrease below 100 cu meters per sec. Both model and observations agree that between 70 and 100% of the ammonia in the Potomac is removed by oxidation of ammonia to nitrous oxide. The rate of nitification is lowered by a factor of 1.6 for a reduction in water temperature of 10 degrees C, in agreement with results for bacteria cultures, which gave factors of 1.5-2.2. The model is also applicable to the Delaware River. (Cassar-FRC)  
W82-00777

BEHAVIOR AND TRANSPORT OF MICROBIAL PATHOGENS AND INDICATOR ORGANISMS IN SOILS TREATED WITH ORGANIC WASTES, Florida Univ., Stanford. Inst. of Food and Agricultural Sciences.  
K. R. Reddy, R. Khaleel, and M. R. Overcash. *Journal of Environmental Quality*, Vol 10, No 3, p 255-266, July-September, 1981. 1 Fig, 7 Tab, 82 Ref.

Descriptors: \*Bioindicators, \*Pathogens, Soil disposal fields, Land disposal, Animal wastes, \*Soil properties, Wastewater disposal, Organic wastes, Farm wastes, Viruses, Runoff, Water quality, Soil contamination, Mathematical models, Mathematical equations.

The survival rate of microbial pathogens in the soil after application of wastes is one of the most important factors in determining the number of organisms available for rainfall-runoff transport. A simple conceptual model based on the current state of the art was developed to describe pathogen and indicator organism behavior in land areas receiving animal wastes. The model was used to examine the effects of die-off rate and retention by soil particles on runoff water quality. Microbial die-off was described, assuming first-order kinetics. First order die-off rate constants were calculated from the literature for various pathogens and indicator organisms in soil-water systems. Correction factors were presented to adjust rate constants for changes in temperature, moisture, and pH of the soil. A 10 degree C rise in temperature was found to double the die-off rates of the organisms studied. Die-off rates also increased with a decrease in soil moisture. Soils with pH between 6 and 7 had slow die-off rates. A linear isotherm was assumed in describing the retention of pathogens and indicator organisms by soil particles. Increases in soil surface area and clay content of the soil resulted in increases in the retention of viruses. Leaching and surface runoff transport processes were considered both for land areas receiving direct applications of animal wastes and for pastures and rangeland watersheds. Several areas requiring further research with respect to pathogen behavior in soils treated with organic wastes were identified. (Carroll-FRC)  
W82-00797

METHYLATION OF TRIMETHYLTIN COMPOUNDS BY ESTUARINE SEDIMENTS, California Univ., Berkeley. Naval Biosciences Lab. H. E. Guard, A. B. Cobet, and W. M. Coleman, III. *Science*, Vol 213, No 4509, p 770-771, August 14, 1981. 1 Fig, 12 Ref.

Descriptors: \*Tin compounds, \*Methylation, \*Sediments, Fate of pollutants, Chemical reactions, Estuarine environment, Biotransformation, Organotin compounds, Biocides, \*Fouling.

The potential for environmental methylation of trialkyl tin compounds was studied in the laboratory using trimethyltin hydroxide as a model compound and anoxic, organic-rich estuarine tidal flat sediments. After 80 days' incubation, the biologically active sediments produced 2.7 times the amount of volatile tetramethyltin (maximum 2.4% of the added trimethyltin hydroxide) as compared with autoclaved control sediments. No methytin compounds were produced in the absence of added trimethyltin hydroxide or in the presence of trimethyltin hydroxide in seawater or seawater-bentonite. The amount of trimethyltin produced was doubled by additions of 15 g Na<sub>2</sub>S and increased 70% by addition of 0.3 g sodium acetate. Adding these compounds to autoclaved sediments did not affect the amount of trimethyltin produced. These studies demonstrate a possible abiotic pathway for the formation of trimethyltin by a Lewis-base redistribution of trimethyltin hydroxide. Methylation of tin is probably of minor importance in the environment. It occurs in low yield, and the volatile, water-insoluble product should escape to the atmosphere, not accumulate in the marine environment. It is likely that the tributyltin compounds used widely as antifouling agents would also methylate to a minor degree. (Cassar-FRC)  
W82-00801

URANIUM CONCENTRATION IN THE GROUND WATERS OF THE PULLMAN-MOSCOW BASIN, WHITMAN COUNTY, WASHINGTON, AND LATAH COUNTY, IDAHO, Washington State Univ., Pullman. R. L. Albrook Hydraulic Lab.

V. T. Ichimura, and J. W. Crosby, III. *Northwest Science*, Vol 55, No 1, p 10-22, February, 1981. 6 Fig, 1 Tab, 13 Ref.

Descriptors: \*Uranium, \*Groundwater pollution, \*Groundwater basins, Washington, Idaho, \*Pullman-Moscow Basin, Nuclear track technique, Leaching, Water pollutants, Path of pollutants.

The Pullman-Moscow basin is located in the south-eastern part of Whitman County, Washington, and west-central Latah County, Idaho. A recent increase of uranium exploration and an earlier finding of anomalously high radiation background in samples of basin groundwater prompted this study of the concentration of dissolved uranium in the Pullman-Moscow basin. A high-sensitivity nuclear track technique, capable of detecting concentrations as low as 5 parts per trillion, was used in this study. The sampling procedure included on-site measurements of temperature, pH, and conductivity. Analysis of the samples using the nuclear track technique showed uranium concentrations as high as 25 parts per billion. Any uranium concentration higher than 6.2 parts per billion was considered anomalous. About 6.8% of the samples fell into this category. Clusters of high uranium concentration were located in groundwaters from the east and southeast sections of the Pullman-Moscow basin on or near the basalt-granite rock contact. These higher concentrations of uranium are probably the result of local leaching of uranium from granitic rocks by oxidizing meteoric waters recharging the basin. Deep, high-yield municipal and domestic wells in the central and western parts of the basin were found to contain very low uranium concentrations, probably as a result of the reducing conditions in the deep groundwater environment of the basin. Although attempts to correlate conductivity, pH, and well depth with uranium concentrations demonstrated the absence of any correlation, samples that had high uranium concentrations generally also had high conductivities. (Carroll-FRC)  
W82-00809

CHEMISTRY OF LAKE WATER AND GROUNDWATER IN AREAS OF CONTRASTING GLACIAL DRIFTS IN EASTERN MINNESOTA, Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences. For primary bibliographic entry see Field 2K.  
W82-00821

RETENTION OF RADIONUCLIDES BY SOME AQUATIC FRESH WATER PLANTS, Atomic Energy Establishment, Cairo (Egypt). Radiation Protection Dept.

R. M. K. El-Shinawy, and W. E. Abdel-Malik. *Hydrobiologia*, Vol 69, No 1/2, p 125-129, March, 1980. 4 Tab, 15 Ref.

Descriptors: \*Macrophytes, \*Bioindicators, \*Radioactivity, \*Radioactive wastes, Aquatic plants, Hydrogen ion concentration, Cesium, Cobalt, Plutonium, Water pollution sources, Retention.

Relative uptake and accumulation of Co<sub>60</sub>, P<sub>32</sub>, and Cs<sub>134</sub> by three aquatic macrophytes were determined in the Ismailia Canal, which is adjacent to the Egyptian Nuclear Research Center. The plants were Lemna gibba, a floating plant; Ceratophyllum demersum, a submerged plant near the water's surface; and Potamogeton crispus, a rooted submerged plant. Uptake of radionuclides decreased at increasing pH from 5 to 9. When pH was constant, uptake increased with increased contact time. Concentration factors obtained for Co<sub>60</sub> were higher than those for P<sub>32</sub>, while Cs<sub>134</sub> showed the lowest concentration factors for all three macrophytes. Maximum uptake values were found at all pH values after a contact time from 4 to 12 days. Thus, the tested macrophytes proved to be reliable biological indicators. They may be used in studies to develop safe limits for disposal of low level radioactive wastes and to evaluate the hazards of the accidental release of radioactivity to the canal water. (Small-FRC)  
W82-00853

METHODS OF INVESTIGATING THE STATE OF METAL IONS IN NATURAL WATERS, Akademiya Nauk URSS, Kiev. Inst. Hidrobiologii. For primary bibliographic entry see Field 5A.  
W82-00859

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

#### **WATERBORNE METHYLENE BIS(2-CHLOROANILINE) AND 2-CHLOROANILINE CONTAMINATION AROUND ADRIAN, MICHIGAN,**

Food and Drug Administration, Washington, DC.

G. E. Parris, G. W. Diachenko, R. C. Entz, J. A.

Poppiti, and P. Lombardo.

Bulletin of Environmental Contamination and

Toxicology, Vol 24, No 4, p 497-503, 1980. 1 Fig, 2

Tab, 6 Ref.

**Descriptors:** \*Organic compounds, \*Contamination, \*Wastewater, \*Environmental effects, \*Industrial waste, Chemical wastes, Chlorine, Water pollution, Lagoons, Waste treatment, Discharge frequency, Flow discharge, Fish physiology, Toxicity, Carcinogens, Fish populations, Water sampling, Streams, Adrian, \*Michigan.

Results which trace waterborne methylene bis (2-chloroaniline) (M2CA) and 2-chloroaniline (2CA) contamination from an industrial waste treatment lagoon in Michigan through the municipal wastewater treatment plant and surface runoff to a stream are reported. Sludge, sediment, fish, and water samples were collected and analyzed. Samples were extracted successively with ethyl acetate and methanol, and analyzed on gas chromatographic columns. M2CA was the dominant compound in the waste lagoon sediment, while 2CA is the dominant compound at the sewage treatment plant sludge. The 2CA may be more readily mobilized through the wastewater systems because of its water solubility or lesser tendency to sorb to sediments. Contamination was found in a deep well on the manufacturing site and in surface runoff from the site. No M2CA was detected in water from the Raisin River near the sewage treatment plant outlet. Possible traces of M2CA were found in the influent and effluent water from the municipal sewage treatment plant. Results of the fish tissue analysis suggest that the contaminant residues are chemically bound to macromolecules of the tissue. (Titus-FRC)

W82-00873

#### **ABSORPTION OF FENITROTHION BY PLANKTON AND BENTHIC ALGAE,**

Moncton Univ., (New Brunswick).

J. S. S. Lakshminarayana, and H. Bourque.

Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 389-396, 1980. 1 Fig, 1 Tab, 26 Ref.

**Descriptors:** \*Absorption, \*Uptake, \*Benthos, \*Pesticides, Forestry, Accumulation, Benthic fauna, Benthic flora, Plankton, Aquatic life, \*Lakes, Organic compounds, Water pollution, Zooplankton, Environmental effects, Water sampling, Fenitrothion, Fate of pollutants, \*Peabody Lake, New Brunswick, Canada.

Results of a preliminary survey on the response of plankton and benthic algae of Peabody Lake in New Brunswick, Canada to fenitrothion spray formulations are presented. Fenitrothion is an organophosphate insecticide used selectively for forest protection against the spruce budworm. The survey indicates that concentrations of fenitrothion diminish rapidly under conditions where water temperatures and pH values ranged from 11 to 15 degrees Centigrade and 6.1 and 7.2 respectively. Fenitrothion is actively taken up by plankton to a degree that depends on various environmental conditions including growth rates, seasonal variation, and bloom formation. The algal species observed in the Peabody lake did not suggest any toxicity or polluted conditions. (Titus-FRC)

W82-00874

#### **MERCURY AND SELENIUM CONCENTRATIONS IN FISH, SEDIMENTS, AND WATER OF TWO NORTHWESTERN QUEBEC LAKES,**

Noranda Research Centre, Pointe Claire (Quebec).

Process Technology Dept.

M. R. Speyer.

Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 427-432, 1980. 3 Tab, 15 Ref.

**Descriptors:** \*Fish populations, \*Sediments, Water pollution, \*Lakes, Heavy metals, Toxicity, Fish

physiology, \*Mercury, \*Selenium, Environmental effects, \*Fish toxins, Ecosystems, Trace metals, Aquatic environment, Aquatic organisms, Chemical analysis, \*Quebec.

Findings of a detailed study conducted in Quebec are presented. The study concerned mercury in the aquatic ecosystem and techniques to reduce the toxicity of mercury accumulated by aquatic organisms. The interaction between mercury and selenium in biological systems in both antagonistic and synergistic. Fish samples from two lakes were obtained and analyzed for mercury and selenium. Results showed significant differences between the mercury and selenium concentrations of fish samples from the two lakes. Elevated selenium concentrations in fish from Lake Dufault corresponded to elevated background selenium concentrations. The two lakes have similar physical dimensions and mining histories, but have different types of bottoms. Lake Dufault has a heavy-metal enriched sludge sediment covered by glacial clay, while Lake Duparquet has a fine silt overlying glacial clay. (Titus-FRC)

W82-00876

#### **ENRICHMENT OF THE AGRICULTURAL HERBICIDE ATRAZINE IN THE MICROSURFACE WATER OF AN ESTUARY,**

Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.

T. L. Wu, L. Lambert, D. Hastings, and D.

Banning.

Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 411-414, 1980. 1 Fig, 1 Tab, 10 Ref.

**Descriptors:** \*Agricultural chemicals, \*Agricultural runoff, Crop production, \*Estuaries, \*Plankton, Agricultural watersheds, Agriculture, Farm wastes, Water pollution, Organic compounds, Diffusion, Convection, Pollutants, Water sampling, Pelagic water, Seasonal variation, \*Herbicides, \*Atrazine.

Results of a study of the distribution and concentration of atrazine in the Rhode River estuary in Maryland are presented. Atrazine is an herbicide commonly used to control broadleaf weeds and grasses in cornfields. During two seven-month sampling periods the peak concentrations were detected in August. Concentrations in microsurface and bulk water decreased in October. The effects of a high concentration of herbicides in the microsurface layer on the diversity and species composition of bacteria, phytoplankton, submerged macrophytes, and zooplankton exposed to the surface microlayer are not known. (Titus-FRC)

W82-00877

#### **THE IMPACT OF AN INDUSTRIALLY CONTAMINATED LAKE ON HEAVY METAL LEVELS IN IT'S EFFLUENT STREAM,**

Purdue Univ., Lafayette, IN. Dept. of Radioisotopes.

T. G. Adams, G. J. Atchison, and R. J. Vetter.

Hydrobiologia, Vol. 69, No 1/2, p 187-193, March, 1980. 1 Fig, 6 Tab, 27 Ref.

**Descriptors:** \*Cadmium, \*Zinc, \*Stream degradation, Lakes, Stream pollution, Ecology, \*Industrial wastes, Atomic absorption spectroscopy, Heavy metals, Water quality, Water pollution. Palestine Lake, Indiana, \*Electroplating, Wastewater.

Levels of cadmium and zinc were determined in a stream receiving water from an industrially contaminated lake. Water samples were collected in Williamson Ditch (a contaminated stream flowing into Palestine Lake), Trimble Creek (a stream draining Palestine Lake), and the Tippecanoe River (a river receiving Trimble Creek). Atomic absorption spectrophotometry was used to analyze water, sediment, plant, fish, and clam samples. In Trimble Creek unweighted mean metal concentrations were: water, 51 microgram Zn/liter, 4.2 microgram Cd/liter; sediment, 592 microgram Zn/g, 48.4 microgram Cd/g; plants, 375 microgram Zn/g and 7.91 microgram Cd/g; fish, 145 microgram Zn/g and 6.02 microgram Cd/g. In general, concentrations were higher in Williamson Ditch and

lower in the Tippecanoe River. The water is polluted by wastes from an electroplating plant. Results indicate that a large percentage of the metal wastes are not held in the lake. The stream which is the outlet for the lake contains metals in concentrations higher than background levels reported for other aquatic systems. (Small-FRC)

W82-00886

#### **DEGRADATION OF HYDROCARBONS IN OXIDIZED AND REDUCED SEDIMENTS,**

Louisiana State Univ., Baton Rouge, Lab. for Wetland Soils and Sediments.

R. D. Delaune, G. A. Hambrick, III, and W. H.

Patrick, Jr.

Marine Pollution Bulletin, Vol 11, No 4, p 103-106, April, 1980. 5 Fig, 10 Ref.

**Descriptors:** \*Degradation, \*Hydrocarbons, \*Sediments, Wetlands, Gulf of Mexico, Oxidation, \*Salt marshes, \*Louisiana, Oxidation-reduction potential, Anaerobic conditions, Aerobic conditions.

The effect of sediment oxidation-reduction or redox potential on hydrocarbon degradation was investigated in samples collected from a Gulf Coast salt marsh. Carbon-14 labelled octadecane, an alkane hydrocarbon, and carbon-14 labelled naphthalene, an aromatic hydrocarbon, were used in this study. Both of these hydrocarbons were very stable in the anaerobic sediment. Naphthalene did not degrade at all in the anaerobic sediment. Naphthalene showed less degradation in both oxidized and reduced sediment than did octadecane. Hydrocarbon degradation was significantly increased by a shift from strict anaerobic conditions in the sediment, where the hydrocarbons are stable and only a few microbial species function, to aerobic sediment conditions where aerobic and facultative anaerobic bacteria function. The redox profile of the sediment cores showed a distinct oxidized surface layer, between 5 and 10 millimeters thick, in which hydrocarbons were oxidized. Beneath this layer, anaerobic conditions, in which hydrocarbons did not degrade, prevailed. The study results clearly demonstrate that petroleum hydrocarbons in estuarine environments are significantly affected by the oxidation-reduction status of the sediment in contact with the hydrocarbons, and that aromatic hydrocarbons which enter an anaerobic sediment environment may persist. (Carroll-FRC)

W82-00907

#### **CHEMICAL COMPOSITION OF LABILE FRACTIONS IN DOM,**

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.

For primary bibliographic entry see Field 2H.

W82-00917

#### **MACROBENTHOS OF PINE ISLAND BAYOU IN THE BIG THICKET NATIONAL PRESERVE, TEXAS,**

Lamar University, Beaumont, TX. Dept. of Biology.

For primary bibliographic entry see Field 5C.

W82-00924

#### **TRANSPORT OF SALTS IN SOILS AND SUBSOILS,**

Volcani Inst. of Agricultural Research, Bet Dagan (Israel). Div. of Soil Physics.

E. Bresler.

Agricultural Water Management, Vol 4, No 1-3, p 35-62, 1981. 14 Fig, 23 Ref.

**Descriptors:** \*Salts, \*Soil water, \*Estimating equations, Flow, Mathematical studies, Infiltration, Evaporation, Arid lands, Salinity, Water quality, \*Israel, Agriculture, \*Solute transport.

Factors affecting the movement of salts in saturated and unsaturated soils and subsoils under dryland conditions are reviewed. The transport occurring in homogeneous soils is described, and the factors affecting salt transport are quantitatively formulated. Equations are presented which describe combined diffusion-convection transient transport and

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

miscible displacement of salts and non-steady water flow. Equations and boundary conditions are described for infiltration, redistribution, and evaporation, in terms suitable for mathematical modeling. One-dimensional vertical profiles of non-interactive salts are described for homogeneous, bare fallow soil. Where physico-chemical interaction takes place between solution and soil matrix, these effects are considered. Also, vegetation effects are considered. Salt dispersion and distribution in heterogeneous fields are also discussed, including the concentration distributions for steady and transient leaking. A knowledge of these processes makes possible the development of optimum management practices to prevent the salinization of groundwaters, streamflows, and farmland. (Small-FRC) W82-00930

**EVALUATION OF WINTER APPLICATION OF LIQUID SLUDGE TO FARMLAND,**  
Guelph Univ. (Ontario). Dept. of Land Resource Science.  
T. Bates, J. W. Ketcheson, R. A. Johnston, and Y. K. Soon.  
Water/Engineering and Management, Vol REF, No HB, p R155-156, 1981. 2 Tab.

Descriptors: \*Sludge, \*Land disposal, Runoff, Seasonal variation, Nitrogen, Phosphorus, Farms, Rainfall, Snowmelt, Thaw, Heavy metals, Water pollution sources, Path of pollutants, Ontario.

Field runoff was investigated from fall, winter, and spring applied sludge over a five year period on a silt loam soil at a location north of Guelph, Ontario. Rainfall averaged 858 mm and snowfall averaged 1,618 mm. Fluid anaerobically digested sludge from the North Toronto treatment plant was used for the study. Sewage was treated with ferric chloride for phosphorus removal and received secondary treatment with activation. Sludge was applied at 200 and 800 kg N/ha/hectare rates on areas with 2% and 6% slopes. Treatments were replicated twice on each slope. Water was collected after each runoff event and total runoff, solids, and total and soluble nitrogen, phosphorus and metals were measured. Total runoff in winter was four times as much as in summer, with very little difference between the 2% and the 6% slopes. In summer there was more runoff from the steeper slope. Annual losses of N and P ranged from less than 1% to 10% of that applied and were greater in summer except for January, when total N losses were greater in the winter. Nearly all the nitrogen and phosphorus in winter runoff was water soluble, but in summer runoff only 1-2% was water soluble. Losses of nitrogen and phosphorus were high from November and January applied sludge when rainfall or snow melt immediately followed sludge application. The North Toronto sludge was low in metals, but some metal losses did occur, with the effects of slope and time of application similar to those for nitrogen and phosphorus. It was noted that fluid sludge should not exceed 1.5 cm depth on the soil surface nor supply more than the crop requirements for available nitrogen. Fluid sludge should not be applied near waterways. (Baker-FRC) W82-00952

**THE FATE OF HEAVY METALS IN THE RUHR SYSTEM AND THEIR INFLUENCE ON DRINKING WATER QUALITY,**  
Ruhrverband, Essen (Germany, F. R.).  
K. R. Imhoff and P. Koppe.  
Water Science and Technology, Vol 13, No 3, p 211-225, 1981. 4 Fig, 9 Tab, 18 Ref.

Descriptors: \*Heavy metals, \*Nickel, \*Drinking water, Path of pollutants, \*Ruhr River, Sediments, Water pollution control, \*Industrial wastewater, Artificial recharge, Recharge, Infiltration, Chelation, Water treatment, Wastewater treatment, Adsorption, Pretreatment of water, Sludge disposal, Water quality control, Manganese, Zinc, Lead, Chromium.

Nickel is used to illustrate the path of heavy metals from the factory to the drinking water supply of the heavily populated and industrialized Ruhr River basin. Ni concentrations (in mg per liter) in

various influents and effluents are as follows: untreated wastewater from the 300 electroplating plants in the basin, up to 1,000; pretreated effluent, 10; combined industrial and municipal wastewater influent, 0.5; municipal treatment plant effluent, 0.3; river water (flow 40 cu meters per sec) downstream of the effluent discharge, 0.05; and waterworks reservoir, 0.04. Drinking water obtained from artificial groundwater recharge contains 7.9 micrograms per liter of Ni, and from bank infiltration, 4.5 micrograms per liter (original river water, about 38.5 micrograms per liter). Most heavy metals decreased similarly in the path from water supply source to tap, with the exception of Mn in bank filtration and Cu in artificial groundwater recharge. In the distribution system concentrations of Zn decreased; Pb, Cr, and Cd did not change; and Cu and Ni increased to 62 and 13 micrograms per liter, respectively. Measures are suggested to further reduce heavy metals in drinking water: supervision in industries and avoidance of complexing agents in industry and detergents. Other problems are the high levels of metals in land applied sewage sludge and possible mobilization of metals from river sediments and subsoil. (Cassar-FRC) W82-00962

**ASSOCIATIONS AND MESOSCALE SPATIAL RELATIONSHIPS AMONG RAINWATER CONSTITUENTS,**  
Illinois State Water Survey, Urbana.

For primary bibliographic entry see Field 2B. W82-00964

**SULFUR AND ASSOCIATED ELEMENTS AND ACIDITY IN CONTINENTAL AND MARINE RAIN FROM NORTH FLORIDA,**  
Florida State Univ., Tallahassee. Dept. of Oceanography.

For primary bibliographic entry see Field 2B. W82-00965

**TRENCHING OF DIGESTED SLUDGE,**  
Science and Education Administration, Beltsville, MD.

For primary bibliographic entry see Field 5E. W82-00974

**BIOCONCENTRATION OF PESTICIDES BY EGG MASSES OF THE CADDISFLY, TRIAENODES TARDUS MILNE,**  
Illinois Natural History Survey, Urbana.

D. Belluck, and A. Felsot.  
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 299-306, March, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: \*Eggs, \*Caddisflies, \*Bioaccumulation, \*Pesticides, Aquatic insects, Biological magnification, Solubility, Fate of pollutants, Organic compounds.

Significant quantities of pesticides were accumulated by caddisfly egg masses (*Triadenodes tardus Milne*) from water with the following concentrations of pesticides: DDD, DDT, and HCB, 1 ppb; carbofuran, 8 ppb; dieldrin, 20 ppb; and methoxychlor, terbufos, malathion, diflubenzuron, and monuron, 100 ppb. The maximum bioconcentration factors, which correlated with physicochemical properties of the pesticides, were as follows: DDD, 2580; HCB, 550; DDT, 250; dieldrin, 100; methoxychlor, 80; diflubenzuron, 20; terbufos, 10; and carbofuran, malathion and monuron, zero. DDD, HCB, and DDT bioconcentration factors reached a peak at 72-96 hours, then declined sharply. Dieldrin and methoxychlor curves were not declining by the end of the 120 hour test. The remainder of the pesticides showed a small rise at 72-96 hours and decreased slightly. A strong correlation existed between water solubility of the pesticides and 72 hour bioconcentration factors. (Cassar-FRC) W82-00982

**ROLE OF SOLUTE-TRANSPORT MODELS IN THE ANALYSIS OF GROUNDWATER SALINITY PROBLEMS IN AGRICULTURAL AREAS,**

Geological Survey, Reston, VA.

L. F. Konikow.

Agricultural Water Management, Vol 4, No 1/3, p 187-205, 1981. 11 Fig, 1 Tab, 20 Ref.

Descriptors: \*Salinity, \*Groundwater, Farming, Groundwater movement, Soil properties, Model studies, Solute transport, Salts, Surface-groundwater relationships, Hydrology, \*Agricultural watersheds.

Accurate technical evaluations of the sources of salinity and of salt transport in a variety of hydrogeologic settings are important if control of groundwater salinity in agricultural areas is to be achieved. Two examples are given which illustrate the crucial role of groundwater in transporting and dispersing salts through a local or regional aquifer to the land surface or into a surface water body and the value of a model as an investigative tool to understand the processes and parameters controlling the movement and fate of the salt. The purpose of a model that simulates solute transport in groundwater is to compute the concentration of a dissolved chemical species in an aquifer at any specified place and time. The increase in salinity of groundwater and surface water in the Arkansas River Valley of south-eastern Colorado is primarily related to irrigation practices. An 18 km reach of the valley was selected for a detailed study. A detailed study was also performed in a nonirrigated area of a wheat field on a dryland farm in the South Platte River valley, near Denver. The model was also used to test some possible water management alternatives, including the coupling of artificial recharge with construction and operation of hydraulic sinks along the northern boundary of the Rocky Mountain Arsenal, which is adjacent to the dryland farm area. Such complex engineering solutions may be feasible in cases where the salt problem is predominantly related to an isolated and specific industrial activity, as is the case here. However, use of such measures in areas where salt seeps out due to agricultural activities is not likely to be helpful. (Baker-FRC) W82-00993

**DETERMINATION OF PICOGRAM AMOUNTS OF TECHNETIUM-99 BY RESIN BEAD MASS SPECTROMETRIC ISOTOPE DILUTION,**  
DuPont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.

For primary bibliographic entry see Field 5A. W82-00999

**HEAVY METAL CONTENTS IN SOME MACROPHYTES FROM SAGINAW BAY (LAKE HURON, U.S.A.),**  
Cranbrook Inst. of Science, Bloomfield Hills, MI. J. R. Wells, P. B. Kaufman, and J. D. Jones.  
Aquatic Botany, Vol 9, No 2, p 185-193, September, 1980. 1 Tab, 11 Ref.

Descriptors: \*Heavy metals, \*Macrophytes, \*Lakes, Water pollution control, Algae, Bioaccumulation, Water pollution effects, Lake Huron, \*Saginaw Bay.

An investigation was designed to see which aquatic species, if any, offered potential for the removal of heavy metals from freshwater lakes. During the summer of 1977 in Saginaw Bay (Lake Huron), 71 plants representing 22 species were collected and analyzed for heavy metal content. Neutron activation analysis was used to measure levels of Ag, As, Ba, Cd, Ce, Co, Cr, Cs, Ni, Rb, Sb, Se, Th, U, and Zn in the 21 macrophytes and one green alga. Both submersed and emergent species showed considerable accumulations of a range of metals. Different organs of the same species or of the same plant were found to vary widely in concentrations of the same element. Highest element uptake amounts were found near the mouth of the Saginaw River. Some plants growing in the polluted bay contained lower amounts of certain metals than did plants of the same species growing in a wilderness area. Thus, plants can accumulate large amounts of metals, but these high concentrations may not result from water pollution. (Small-FRC) W82-01000

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

**SALINE SEEP DEVELOPMENT AND CONTROL IN THE NORTH AMERICAN GREAT PLAINS - HYDROGEOLOGICAL ASPECTS,** Montana Bureau of Mines and Geology, Butte. M. R. Miller, P. L. Brown, J. J. Donovan, R. N. Bergatino, and J. L. Sondergaard.

Agricultural Water Management, Vol 4, No 1/3, p 115-141, 1981. 14 Fig, 2 Tab, 30 Ref.

Descriptors: \*Seepage, \*Salinity, Chemical properties, \*Groundwater, Contamination, Water pollution sources, Groundwater movement, Seepage control, Hydrology, Geohydrology, Groundwater hydrology, Farming, Path of pollutants, \*Great Plains.

Hydrogeological aspects of saline seeps are discussed, emphasizing the formation and development, regional extent and potential impacts, and effective control practices for such seeps. Dryland salinity is caused by a combination of cultural, climatic, and hydrogeological conditions. The process begins with excess water percolating down beneath the root zone, picking up soluble salts, accumulating on shallow, less-permeable layers, and forming a local groundwater flow system which moves saline water from the recharge to the discharge area or seep, where it evaporates, depositing the salts on the surface. Geological conditions favorable for such development exist throughout the Northern Great Plains region. There, sufficient soluble salts are available in the upper 6 meters of the soil profile to continue existing saline seeps for the next 25-100 years. Shallow groundwater resources appear to be showing signs of contamination by the saline seep process. High concentrations of dissolved solids, nitrates, and selenium are the most troublesome. Alternate crop-fallow farming techniques allow significant quantities of water to move beneath the root zone, activating the local groundwater flow system and contributing to dryland salinity. The use of deep-rooted perennial crops, flexible cropping systems, and surface drainage of cultivated upland recharge areas will help control dryland salinity. Research results are presented from ten years of study on a typical site, the Hanford-Bramlette test area, about 56 km northeast of Great Falls, Montana, with an area of about 65 ha. (Baker-FRC)

W82-01022

**IMPACT OF WATER RESOURCE DEVELOPMENT ON SALINIZATION OF SEMI-ARID LANDS,** California Univ., Davis. School of Civil Engineering.

G. T. Orlab, and A. Ghorbanzadeh. Agricultural Water Management, Vol 4, No 1/3, p 275-293, 1981. 9 Fig, 14 Ref.

Descriptors: \*Salt balance, \*River basin, \*California, \*San Joaquin River, Drainage, Catchment areas, Model studies, Rivers, Farming, \*Tile drainage, Semiarid lands.

The development of water resources in the San Joaquin Valley of California is reviewed. The valley is one of the most productive agricultural areas of the world. All of its major rivers have been regulated for power production, water supply, flood control and irrigation. Through the Central Valley Project water was impounded and subsequently diverted to the Tulare Basin to the south. This water was replaced in part by importation from the Sacramento-San Joaquin Delta through the Delta Mendota Canal. This deprived the main river system downstream of Mendota of normal runoff and has led to a serious impact on agriculture in the northern portion of the valley. Changes in water quality have been noted, particularly a reduction in diluting flows of natural runoff and increases in salt accretions to the natural drainage courses due to irrigation drainage. By analyzing runoff and water quality at a sufficient number of locations along the San Joaquin River it was determined that virtually all of the sulfate that reaches Vernalis originates with drainage upstream of the mouth of the Merced River. The salt load carried by the San Joaquin River is steadily increasing. An important step in rectifying the basin's salt balance will be the installation of drainage facilities to convey out of the basin accretions

from discrete sources. This will include tile drainage. Model studies have been made, based on the Galerkin-type Finite Element Method. A brief description of one case study using this model is presented. (Baker-FRC)

W82-01024

### LEACH CHARACTERISTICS OF COAL-GASIFICATION CHAR

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.

R. Luthy, P. Vassiliou, and M. J. Carter.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 81-103, February, 1980. 9 Fig, 6 Tab, 20 Ref.

Descriptors: \*Leaching, \*Coal gasification, Gasification, \*Char, Infiltration, Percolation, Leachates, Carbon, Boron, Molybdenum, Metals, Acidity, Groundwater pollution, Irrigation water, Industrial wastes, Path of pollutants.

Attempts were made to quantify the extent and rate of release of trace elements from char when leached with eluants of varying qualities. Char is produced when carbon conversion is incomplete. The solid waste evaluated here was Hygas western coal char formed at about 63% carbon conversion. In a continuous-flow leaching experiment, 200 g of char was placed loosely in the leaching columns without compaction. Leachate and digested char samples were analyzed for 22 elements using simultaneous multielement analysis by inductively coupled argon-plasma atomic emission spectroscopy. Six different leaching solutions were used: distilled water (simulating rainwater), model intermediate hard water (simulating a typical surface water), model hard water, model acid mine water, acetate-tartrate/hydrosulfite eluant, and deaerated (boiled) tap water (simulating a mildly acidic mineral water with low buffering capacity). The amount of material extracted depended on the nature and strength of the extractant, with pH and buffer capacity of the extractant being important factors. Boron poses a leaching problem due to its deleterious effects on irrigation waters. Molybdenum was the only heavy metal species routinely identified in the leachate, excluding the acetate-tartrate experiment. This could be a problem, as ground waters carry levels of this element that can give rise to plant concentrations toxic to cattle. (Baker-FRC)

W82-01025

### UPTAKE OF POLYCHLORINATED BIPHENYLS BY NATURAL PHYTOPLANKTON ASSEMBLAGES: FIELD AND LABORATORY DETERMINATION OF C14-PCB PARTICLE-WATER INDEX OF SORPTION

Texas A and M Univ., College Station. Dept. of Oceanography.

D. C. Biggs, C. D. Powers, R. G. Rowland, H. B. O'Connors, Jr., and C. F. Wurster.

Environmental Pollution, (Series A) Vol 22, No 2, p 101-110, June, 1980. 3 Fig, 2 Tab, 19 Ref.

Descriptors: \*Polychlorinated biphenyls, \*Phytoplankton, \*Sorption, Algae, Accumulation, \*Fate of pollutants, Chlorinated hydrocarbons, Pesticides, Estuarine environment, Long Island Sound.

Uptake of C14-polychlorinated biphenyls (PCB, 54% chlorine) by a natural phytoplankton community and particulate matter was studied in glass containers in the laboratory and in dialysis cultures in Long Island Sound. Particles at a concentration of 25 million cm micrometers per ml took up 19-22% of the PCB, leaving 1-3% on the glass walls of the container and 70-72% in the water. At particle concentrations 4-fold higher, particles adsorbed 66-69% of the PCB, leaving 22-23% in the water. The percentage sorption appeared to be independent of the PCB concentration (3.8 and 11.6 micrograms per liter) used. Heat-killed cells sorbed significantly more PCB than live particles. In desorption experiments, most of the PCB leached from the particles within 5 days when dialyzed against PCB-free water. The water lost PCB more rapidly than the particles. The ratio of PCB sorbed to particles to that in an equal volume of water averaged 20,000. (Cassar-FRC)

W82-01032

### UPTAKE AND TRANSFER OF THE CHLORINATED HYDROCARBON LINDANE (GAMMA-BHC) IN A LABORATORY FRESHWATER FOOD CHAIN

Hamburg Univ. (Germany, F.R.) Inst. fuer Hydrobiologie und Fischereiwissenschaft.

For primary bibliographic entry see Field 5C. W82-01033

### TRACE METAL FLUXES TO NEARSHORE LONG ISLAND SOUND SEDIMENTS

New Hampshire Univ., Durham. Dept. of Earth Sciences.

W. B. Lyons, and W. F. Fitzgerald.

Marine Pollution Bulletin, Vol 11, No 6, p 157-161, June, 1980. 1 Fig, 5 Tab, 31 Ref.

Descriptors: \*Trace metals, \*Marine sediments, \*Long Island Sound, \*Bottom sediments, Sediment, Metals, Lead, Zinc, Cadmium, Silver, Iron, Manganese, Copper, Fluctuations, Estuaries.

Sediments can act as 'sinks' or 'traps' for trace metals in the coastal marine environment. The concentrations and fluxes of iron, manganese, copper, lead, cadmium, zinc, and silver in the sediments of two nearshore areas in Long Island Sound were investigated. The calculated natural metal fluxes of iron, manganese, zinc, cadmium, and silver for the Mystic River estuary, which is representative of the nearshore sedimentary environment of the eastern part of the Sound, were found to resemble those of the Santa Barbara Basin and the Baltic Sea rather than those of other New England estuaries. The natural fluxes of copper and lead at this site are the lowest ever reported. There was no correlation between increases in cadmium, copper, lead, silver, and zinc in the uppermost sediments and increases in organic carbon. The concentrations of these metals were all strongly correlated with each other, suggesting that they are due to increases in human activity. However, there was no strong relationship between these metals and iron. The calculated fluxes for the Branford Harbor sediments, located offshore from a more industrialized area on the western part of the Sound, resembled those of other New England estuaries. The higher anthropogenic fluxes of metals found at Branford Harbor, as compared to those at the Mystic River site, indicate greater inputs of metals in the western and central portion sections of the Sound due to human activity. Increased trace metal concentrations in the sediments of the Sound proceeding from east to west support this conclusion. Metal concentrations in the sediments at various locations appear to mirror the location of the introduction of the metals into the estuarine system. The highest metal fluxes in the sediments occurred at sites closest to known sources of anthropogenic metal inputs. (Carroll-FRC)

W82-01040

### DISPERSAL OF SALMONELLA FROM A POLLUTED STREAM TO NEIGHBORING TERRESTRIAL HABITATS

Elmhurst Coll., IL. Dept. of Biology.

For primary bibliographic entry see Field 5A. W82-01043

### EFFECTS OF NITRAPYRIN ON NITRATE MOVEMENT IN SOIL COLUMNS

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.

For primary bibliographic entry see Field 5G. W82-01048

### GROUNDWATER QUALITY MODELS - STATE OF THE ART

Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.

For primary bibliographic entry see Field 5G. W82-01061

### EFFECTS OF RENTON WASTEWATER TREATMENT PLANT EFFLUENT ON WATER QUALITY OF THE LOWER GREEN/DUWAMISH RIVER

For primary bibliographic entry see Field 5G. W82-01062

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

Washington State Dept. of Ecology, Olympia.  
For primary bibliographic entry see Field 5D.  
W82-01063

**THE IMPACT OF EFFLUENT FROM THE RENTON WASTEWATER TREATMENT PLANT ON THE DISSOLVED OXYGEN REGIMEN OF THE LOWER GREEN/DUWAMISH RIVER.**  
Washington State Dept. of Ecology, Olympia.  
For primary bibliographic entry see Field 5D.  
W82-01064

**AN INDUSTRIAL AND HAZARDOUS WASTE INVENTORY OF WASHINGTON'S MANUFACTURING INDUSTRIES (1980),**  
Washington State Dept. of Ecology, Olympia.  
D. M. Kruger.  
Document WDOE 81-4, February 1981. 28 p. 4  
Fig. 12 Tab, 9 Ref, 3 Append.

Descriptors: \*Industrial wastes, \*Waste management, Inorganic compounds, Waste characteristics, \*Landfills, \*Hazardous materials, Organic wastes, Toxins, Waste dumps, Solid waste disposal, Waste disposal, Wastes, Wastewater lagoons, \*Washington, \*Hazardous waste inventory.

The State of Washington is currently developing a statewide hazardous waste management program. Over 500 manufacturing industries, representing 15 percent of Washington industries, were sent an inventory to obtain information on the amount, type, chemical nature (organic or inorganic), and ongoing management practices for treatment, storage, and disposal of industrial and hazardous waste. A total of 350 forms were returned, with 200 industries reporting hazardous waste generation. Inventory information showed that most of Washington's manufacturing waste is inorganic. Nearly 0.4 million tons and 14.3 million gallons of inorganic hazardous waste were generated in 1980. Common waste names reported in the inventory were waste oils, spent solvents, PCB's, heavy metal sludges, paint strippers, pentachlorophenol, metal plating sludges, and spent potliners. Most of the hazardous waste generated in Washington stays in-state. Although a variety of treatment, storage, and disposal methods exist for handling hazardous wastes, in general, little or no treatment technology is employed. Percolation and evaporation lagoons are the primary treatment methods used for liquid wastes. Most solids and sludges are not treated. The primary storage methods for hazardous solids and sludges are piles, while hazardous liquids are stored in pits, ponds, and lagoons. The primary disposal method for solids and sludges is landfilling. Recovery of hazardous wastes, at this time, is the least practiced; less than half the solid hazardous waste is either recycled or reclaimed. (Garrison-Omniplan)  
W82-01065

**ASSESSMENT OF WATER QUALITY CONDITIONS IN SKAMOKAWA CREEK, WASHINGTON,**  
Washington State Dept. of Ecology, Olympia.  
For primary bibliographic entry see Field 5C.  
W82-01066

**WATER QUALITY CONDITIONS IN THE BELLINGHAM BAY AREA 1979-1980,**  
Washington State Dept. of Ecology, Olympia.  
R. F. Stanley.  
Document DOE 80-14, December, 1980. 13 p. 2  
Fig. 4 Append.

Descriptors: \*Pulp and paper industry, Mills, \*Wastewater treatment, \*Water quality management, Wood waste, Industrial wastewater, Water quality standards, Effluent, Anaerobic bacteria, Bays, Wastewater disposal, Data collection, \*Bellingham Bay area, \*Washington.

The prime contributor to inner Bellingham Bay's water quality problems, and the focal point of this study, is the pump, paper, and chemical complex operated by the Georgia-Pacific Corporation along the eastern bank of the Whatcom Waterway. This

large industrial facility produces, as its main product, approximately 600 tons of sulfite wood pulp per day. Other products from the mill include wastepaper pulp, semichemical pulp, tissue paper, alcohol, lignin byproducts, sulfuric acid, chlorine, and sodium hydroxide. Wastewaters resulting from these activities approach 50 million gallons per day, and in the past have accounted for more than 90 percent of the oxygen-demanding discharges to the inner harbor. The cumulative effect of these wastes and the resulting buildup of anaerobic sludge deposits on the bottom of the Whatcom Waterway resulted in environmental conditions which virtually excluded all but the very lowest and most resistant life forms. These poor conditions existed until May 1979 when Georgia-Pacific constructed a wastewater treatment plant. Data collected during two Bellingham area receiving water surveys document a major improvement in water quality. Completion of the mill's new treatment system in 1979 included the interception of all major mill waste streams. These streams were then re-routed through the mill's aerated lagoon before being discharged to outer Bellingham Bay. Study data from 1980 indicate that the mill's final effluent had a relatively minor negative impact on the quality of the outer bay waters. Environmental quality within this relatively enclosed portion of the bay continues to be somewhat degraded by remaining anaerobic sludge beds. (Garrison-Omniplan)  
W82-01068

#### WILSON CREEK DRAINAGE - SURFACE AND GROUND WATER QUALITY, JULY 1978 TO JULY 1979.

Washington State Dept. of Ecology, Olympia.  
Document DOE 80-13, November, 1980. 50 p. 12  
Fig. 8 Tab, 13 Ref, 3 Append.

Descriptors: Surface water, Groundwater pollution, Water quality management, Well water, Wastewater treatment, \*Urban runoff, \*Industrial wastewater, \*Agricultural runoff, Irrigation wells, \*Water pollution sources, Effluent standards, On-site data collection, Atomic absorption spectroscopy, \*Wilson Creek, \*Washington, Water pollution effects.  
W82-01093

Surface water and groundwater quality were monitored in Wilson Creek drainage in central Washington State from July 1978 through July 1979 to evaluate impacts of irrigated agriculture, urban runoff, municipal and industrial waste disposal, and residential development. While water in domestic wells was found to meet drinking water standards, shallow irrigation wells contain water of poor bacterial quality and are fit for irrigation purposes only. Kittitas sewage treatment plant (STP) effluent was found to be significantly degrading water quality in Cooke Creek with respect to fecal coliforms, nutrients, and aesthetics. Temperature, pH, and dissolved oxygen were generally within Class A standards in Wilson Creek and its tributaries. Return flows from irrigated agriculture were identified as the cause of increased turbidity, solids, nutrient, and bacteria levels in the central and lower drainage. The other point and non-point sources monitored did not appear to impact water quality significantly. The study area encompassed approximately 190 square miles and involved 59 sampling stations. The four surface water parameters measured on site were temperature, pH, specific conductivity, and dissolved oxygen (Winkler-Azide modification). Eleven other parameters were measured in the laboratory, in addition to tests for total coliforms, chlorides, calcium hardness, and total iron. Field parameters measured in the groundwater study included temperature, pH, specific conductivity, and well water levels. Grab samples of water and sediment were collected once each month for determination of lead, mercury, and zinc content by atomic absorption spectrophotometry. (Garrison-Omniplan)  
W82-01069

**ENTERIC VIRUSES IN RENOVATED WATER IN MANITOBA,**  
Cadmam Provincial Lab., Winnipeg (Manitoba).  
For primary bibliographic entry see Field 5A.  
W82-01090

**ARE METALS FROM HIGHWAY DUSTFALL HAZARDOUS IN SWIMMING POOLS,**  
Florida International Univ., Miami. School of Technology.  
J. A. Beech.

Journal of Environmental Health, Vol 42, No 6, p 328-331, May/June, 1980. 4 Tab, 18 Ref.

Descriptors: \*Swimming pools, \*Highway effects, Heavy metals, Recreation facilities, Highways, Roads, Dusts, Metals, Sediments, Water quality.

The possible effect of roadwar dust on the heavy metal content of swimming pool water was investigated. Water from 20 pools alongside busy highways was compared with water from 80 other freshwater pools classified into four groups by pool location and/or type. All samples came from public or commercial open-air pools, originally filled from the Miami municipal water supply. Powdery sediments were noted on the bottom of several pools alongside busy highways. These sediments were also analyzed. Three pool samples exceeded or equaled interim primary drinking water standards for lead or cadmium. Two of these contained 73 and 50 micrograms per liter of lead and one contained 12.1 micrograms of cadmium. Only 20 pool samples contained less than 100 mg/liter of sodium. Sodium ions are added during routine maintenance. Copper content of the sediments varied greatly. Some sediments contained very large amounts of lead. Pool sediments were somewhat higher in metals than are most roadside dusts. No significant differences were found between soluble heavy metal concentrations of water from pools alongside highways and water from other city pools. Until more is known about the properties of these bottom sediments in pools, it is recommended that they be removed from the entire circulating system when the pools are cleaned. (Baker-FRC)  
W82-01093

### 5C. Effects Of Pollution

**EFFECT OF CRUDE OIL AND PETROLEUM-DEGRADING MICROORGANISMS ON THE GROWTH OF FRESHWATER AND SOIL PROTOZOA,**  
Toronto Univ. (Ontario). Dept. of Zoology.  
A. Rogerian and J. Berger.  
Journal of General Microbiology, Vol 124, No 1, p 53-59, May, 1981. 3 Fig, 21 Ref.

Descriptors: \*Protozoa, \*Oil, \*Growth rates, \*Bacteria, Microorganisms, Water pollution effects, Oil pollution, Microbial degradation, Microbiological studies, \*Crude oil.

The ability of a known oil-degrading microflora to support the growth of several common freshwater and soil protozoa was investigated. Also, the protozoa were cultured with emulsified crude oil to study the effects of their directly ingesting oil globules. The following protozoa were cultured either in the presence or in the absence of partially degraded crude oil: Colpidium campylum, Tetrahymena pyriformis, Colpidium colpoda, Colpoda ciliata and Uroleptus. Also, the soil amoeba Naegleria gruberi was cultured. Comparisons were made using the regression coefficient characterizing the slope of the growth curve. The presence of hydrocarbons in the batch culture system did not consistently affect protozoan growth. Protozoan replication was not deterred by the oil droplets observed within the food vacuoles of ciliates. The protozoa most susceptible to reduced growth rates in the presence of emulsified oil were the small pelagic ciliates. In general, there was a slight tendency towards larger protozoa in the presence of oil. (Small-FRC)  
W82-00517

**ACID RAIN: FACTS AND FALLACIES,**  
Northeastern Forest Experiment Station, Durham, NH.  
J. W. Hornbeck.  
Journal of Forestry, Vol 79, No 7, p 438-443, July, 1981. 3 Fig, 45 Ref.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

Descriptors: \*Acid rain, \*Air pollution, \*Precipitation, Snowmelt, Rainfall, Acidity, Chemical properties, Industrial wastes, Forests, Ecosystems, Vegetation, Soil environment, Leaching, Water pollution effects.

The sources and effects of acid rain are complex environmental phenomena. Although the major sources are thought to be atmospheric emissions, primarily from urban sources, the exact locations of sources and the mechanisms of transformation of emissions to acid rain are not entirely understood. In the absence of long term records, it is difficult to analyze changes in rainfall acidity and whether this problem is intensifying or spreading. Long range transport of airborne emissions by weather systems has made acid rain a potential threat to aquatic and forest ecosystems in rural areas. Acid rain contains not only substances that donate hydrogen ions, such as nitric and sulfuric acid, but also dissolved ions of common and heavy metals and trace elements. Aquatic ecosystems are the most vulnerable to acid rain in the short run. Acidification of streams and lakes may lead to decreased fish populations and increased concentrations of toxic metals. Acid rain may accelerate the replacement and leaching of basic cations and speed the rate of acidification of soils, particularly shallow, coarse textured forest soils which are already lacking in basic cations. This gradual acidification of the soil could increase leaching of nutrient ions, slow microbiological processes, reduce the variety and populations of soil fauna, and increase the mobility of some toxic elements. Acid rain also appears to be depositing heavy metals on forest soils. Long range effects of acid rain may include reduction of forest productivity and alteration of species composition or diversity. (Carroll-FRC)

W82-00518

**SESTON DYNAMICS IN SOUTHERN APPALACHIAN STREAMS: EFFECTS OF CLEAR-CUTTING,**  
Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology.  
For primary bibliographic entry see Field 4C.

W82-00543

**SEDIMENTOLOGICAL AND BIOLOGICAL CHANGES IN THE WINDSOR MUDFLAT, AN AREA OF INDUCED SILTATION,**  
McMaster Univ., Hamilton (Ontario). Dept. of Geology.  
T. R. Turk, M. J. Fisk, R. W. M. Hirtle, and R. K. Yeo.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1387-1397, September, 1980. 10 Fig, 2 Tab, 40 Ref.

Descriptors: \*Tidal powerplants, \*Sedimentation, \*Mud flats, \*Siling, \*Secondary productivity, \*Tidal marshes, Tidal flats, Water resources development, Aquatic productivity, Environmental effects, Sediments, Clams, Polychaetes, Amphipods, Ecological effects, Windsor, \*Nova Scotia.

The effect of rapid sedimentation on the sedimentological and biological properties of an intertidal mudflat was examined at the causeway-formed mudflat at Windsor, Nova Scotia. The sediments on the Windsor mudflat have occurred as a result of construction of a tidal power dam. The Windsor mudflat is characterized by high water levels, small grain sizes and high levels of organic carbon. The amphipod, Corophium volutator and the clam, Macoma balthica are less abundant in the study site than in surrounding mudflats. The polychaete, Heteromastus filiformis is very abundant at Windsor, while M. balthica grows faster and has a shorter lifespan. However, the weight of the Windsor clams increases more slowly with increasing shell size, probably in response to the greater fluidity of Windsor sediments. These findings suggest that the secondary productivity of Corophium and Macoma could be reduced by about 66% for another decade in existing Minas Basin mudflats. (Geiger-FRC)

W82-00548

**RESIDUES IN CUTTHROAT TROUT (SALMO CLARKI) AND CALIFORNIA NEWTS (TARICHA TOROSA) FROM A LAKE TREATED WITH TECHNICAL CHLORDANE,**  
Simon Fraser University, Burnaby (British Columbia). Dept. of Biological Sciences.

L. J. Albright, P. C. Oloffs, and S. Y. Szeto. Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 333-349, 1980. 4 Tab, 13 Ref.

Descriptors: \*Chlorinated hydrocarbons, \*Residual chlorine, Water pollution, Lake sediments, \*Chlordane, Sediments, \*Trout, Fish, Salamanders, Amphibians, Cutthroat trout.

Laboratory studies with chlordane and other chlorinated hydrocarbons showed that these compounds were not metabolized in water but, except for lindane, were readily partitioned into the sediments where some metabolism occurred. A subsequent whole-lake study, conducted to extend these laboratory investigations, involved treatment of a lake with about 10 parts per billion of technical chlordane. The uptake of chlordane residues from the lake water and sediment and their metabolism by two macroorganisms was investigated using the California newt, Taricha torosa, which lives closely associated with the sediment, and the cutthroat trout, Salmo clarki. The newts were collected at 14, 279, 451, and 1,036 days after the water was treated, while the trout were collected at 93, 279, 421, and 1,014 days. Both of the organisms had residue concentrations in their bodies and livers which far exceeded those in their habitat at the first sampling. These first residue concentrations resembled that of technical chlordane, except for heptachlor, which was quantitatively epoxidized in newts after 14 days. Some heptachlor was still present in trout at 93 days. Concentrations of total chlordane in body tissues of both species declined more than 98% by the final sampling. Trans-nonachlor was the most persistent constituent of technical chlordane, accounting for about 50% of the total chlordane in the specimens collected last. Although the chlordane rapidly disappeared from the water into the sediment, the concentrations of total chlordane in the bodies of newts and trout after the samplings taken at 279 days were very similar, suggesting that the newt metabolizes and eliminates chlordane residues more effectively than the cutthroat trout. Both species were found to produce oxychlordane, probably from gamma-chlordane. (Carroll-FRC)

W82-00558

**EFFECT OF TEMPERATURE ON MINERALIZATION BY HETEROTROPHIC BACTERIA,**  
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.

D. L. Tison, and D. H. Pope. Applied and Environmental Microbiology, Vol 39, No 3, p 584-587, March, 1980. 4 Fig, 9 Ref.

Descriptors: \*Thermal pollution, \*Bacteria, Heated water, \*Temperature effects, Waste heat, Thermal powerplants, Thermal stress, Water pollution effects, Thermal water, Algae.

The results of shifts in temperature on the percentage of substrate mineralized (% Min) by pure cultures of psychrotrophic, mesophilic, and thermophilic bacteria and by naturally occurring microbial communities were studied. The possibility that changes in the % Min may be an indication of stress in microbial communities is discussed. Pure cultures of the bacteria *Pseudomonas fluorescens* (a psychrotroph), *Escherichia coli* (a mesophile) and SRL 261 (a thermophile) were shifted away from temperatures to which they were adapted. At this point the % Min increased. The increase was noticeably larger for larger temperature shifts. When natural heterotrophic bacterial populations from sediments of Lake George, New York were subjected to temperature shifts similar responses were noted. The same response was found when a thermophilic algal-bacterial mat community at the Savannah River Plant in Aiken, South Carolina was subjected to temperature shifts. It is suggested that an increase in the % Min may be an indication of thermal stress in bacterial populations. (Baker-FRC)

W82-00583

**SURVIVAL OF HUMAN ENTEROVIRUSES IN THE HAWAIIAN OCEAN ENVIRONMENT: EVIDENCE FOR VIRUS-INACTIVATING MICROORGANISMS,**

Hawaii Univ., Honolulu. Water Resources Research Center.

R. S. Fujioka, P. C. Loh, and L. S. Lau. Applied and Environmental Microbiology, Vol 39, No 6, p 1105-1110, June, 1980. 7 Fig, 1 Tab, 10 Ref.

Descriptors: \*Seawater, \*Enteroviruses, Hawaiian Ocean, Viruses, Temperature effects, Poliovirus, Nutrients, Antibiotics, Microorganisms, \*Hawaii, Oahu.

This report describes the stability of human enteroviruses in the seawaters surrounding Oahu, the major island in the state of Hawaii, and characterizes the virus-inactivating agents present in these waters. The time required for a 90% reduction of poliovirus type 1 at 24 degrees C ranged from 24 to 48 hr. Complete inactivation occurred within 72 to 96 hr. A virus-inactivating agent(s) of a microbial nature was found both in the clean and sewage-polluted seawaters, but not in fresh, mountain stream waters. Antiviral activity disappeared when the seawater samples were subjected to boiling, autoclaving, or filtration through a 0.22- or 0.45-micrometers, but not a 1.0 micrometer membrane filter. The concept that the antiviral activity of the seawater was related to the growth activities of microorganisms was corroborated by the observed effects of added nutrients, a lower temperature of incubation, and the presence of certain antibiotics. Other enteric viruses, such as coxsackie virus B-4 and echo virus-7, were also shown to be similarly inactivated in seawater. (Baker-FRC)

W82-00587

**TOXICITIES OF PARAQUAT AND DIQUAT HERBICIDES TO FRESHWATER COPEPODS (DIATOMUS SP. AND EUVCLOPS SP.),**  
Southern Univ., Baton Rouge. LA. Dept. of Biological Sciences.

S. M. Naqvi, T.-S. Leung, and N. Z. Naqvi. Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 918-920, 1980. 2 Tab, 12 Ref.

Descriptors: \*Paraquat, \*Diquat, \*Copepods, \*Herbicides, Toxicity, Mortality, Crustaceans, Invertebrates, Water pollution effects, \*Aquatic animals, Zooplankton.

Zooplankton were collected from a natural lake with a plankton net. Copepods were separated out by concentrating the sample and removing the upper portion containing the aggregated copepods. Freshwater copepods (Diatomus sp. and Eucyclops sp.) were exposed to various concentrations (0 to 140 ppm) of the herbicides diquat and paraquat for 24 and 48 hours. LC50 results in ppm were: diquat, 74 at 24 hours, 19 at 48 hours; paraquat, 10 at 24 hours, 5.3 at 48 hours. Mortalities of 98-100% were observed at concentrations of 140 ppm diquat and 100 ppm paraquat in 24 hours and 60 ppm diquat and 30 ppm paraquat in 48 hours. The copepods were slightly more tolerant to these herbicides than cladocerans; however, copepod mortality in aquatic ecosystems due to excessive use of diquat and paraquat cannot be ruled out. (Cassar-FRC)

W82-00589

**TOXICITY OF FIVE FOREST INSECTICIDES TO CUTTHROAT TROUT AND TWO SPECIES OF AQUATIC INVERTEBRATES,**

Columbia National Fisheries Research Lab., MO. D. F. Woodward, and W. L. Mauck. Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 846-853, 1980. 3 Tab, 13 Ref.

Descriptors: \*Fish, \*Insecticides, \*Invertebrates, Aquatic life, Toxicity, \*Trout, Water pollution effects, Pesticides, Carbamate pesticides, Organophosphorus pesticides, Acephate, Fenitrothion, Trichlorfon, Aminocarb, Carbaryl, \*Toxicity.

The toxicity of five forest insecticides was determined for cutthroat trout obtained from the Jack-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

son Wyoming National Fish Hatchery and aquatic invertebrates, stonefly nauplii from The Snake River and amphipods collected from small springs. The 96-hour LC<sub>50</sub>s for trout (*Salmo clarki*) in 12 degrees C soft water at pH 7.5 were (in micrograms per liter): acetate 100,000; aminocarb 28,000; carbaryl 3,950; fenitrothion 2,880; and trichlorofon 1,680. For amphipods (*Gammarus pseudolimnaeus*) the 96-hour LC<sub>50</sub> were (in micrograms per liter): acephate 25,000; aminocarb 1,000-2,200; carbaryl 7-13; fenitrothion 4.3-5.6; and trichlorofon 52-108. In stoneflies (*Pteronarcella badia*) the 96-hour LC<sub>50</sub> (in micrograms per liter) were: acephate 6,400-21,200; aminocarb 26-28; carbaryl 11-29; fenitrothion 5.1-7.2; and trichlorofon 5.3-100. It is important to note that toxicity of some insecticides varies significantly (by as much as 300-fold) when they are formulated and applied in water of different pH, hardness, or temperatures. All five insecticides, excluding aminocarb, appear safe to cutthroat trout at pH 7.5 or less at normal formulation and application rates. The aquatic invertebrates are much more sensitive to the toxicants. Acephate is the safest forest insecticide to both trout and invertebrates. However, a 2 lb per acre application rate has shown evidence of cholinesterase inhibition in songbirds. (Cassar-FRC)  
W82-00590

#### ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA

Radiation Management Corp., Drumore, PA.  
Muddy Run Ecological Lab.  
D. Mathur, T. W. Robbins, and E. J. Purdy, Jr.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 937-944, June, 1980. 4 Fig, 5 Tab, 13 Ref.

Descriptors: \*Zooplankton, \*Thermal pollution, \*Statistical analysis, Heated water, Temperature effects, Powerplants, Mathematical studies, Conowingo Pond, Pennsylvania.

Analysis of covariance was used to separate natural variations in zooplankton from those caused by power station operation. The covariants were: density of zooplankton at control station, ambient water temperature, and average daily river flows. The assessment was made at Conowingo Pond, a 35.8 km sq impoundment on the lower Susquehanna River which is part of the Peach Bottom Atomic Power Station, a once-through cooling system. Some of the problems associated with using the ratio of density at the control station to the density at an affected station to adjust for ambient variations were overcome using the covariance technique. Significant differences were found in adjusted preoperational and postoperational means, but these were not attributable to station operation. Multiple regression analysis indicated that an increase in zooplankton production could result from the addition of heated water when river flows were less than 280 cu m/sec. Temperature differences from ambient averaged 10C in winter and 8C in summer. (Small-FRC)  
W82-00592

#### EFFECT OF METALS ON THE BIOMASS PRODUCTION KINETICS OF FRESHWATER COPEPODS

Canada Center for Inland Waters, Burlington (Ontario).  
U. Borgmann, R. Cove, and C. Loveridge.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 567-575, April, 1980. 5 Fig, 11 Tab, 12 Ref.

Descriptors: \*Water pollution effects, \*Heavy metals, \*Copepods, \*Toxicity, Cadmium, Copper, Mercury, Lead, Arsenic, Biomass, Aquatic productivity, Canals, Fluctuations, Seasonal variation, Crustaceans, Mathematical studies.

The effects of cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), and arsenic (As) on the kinetics of *in situ* copepod production in the Burlington Canal were examined under static conditions. Nauplii were collected and exposed for two weeks to various concentrations of the metals. Biomass growth rate, mortality rate, cohort bio-

mass growth rate and recoverable metal concentrations were calculated and subjected to mathematical analysis. Results showed seasonal cycles in toxicity for all of the metals except As. Pb toxicity was associated with the ash-free dry weight of the seston, but the fluctuations in Cd, Cu and Hg toxicity could not be explained. Metal toxicity to copepods and daphnids is often more similar in the chronic form than in the acute form. Mathematical relationships between metal levels and growth and mortality rates are presented along with a method for determining sublethal metal concentrations. (Geiger-FRC)  
W82-00593

#### DYNAMICS OF SELENIUM IN MERCURY-CONTAMINATED EXPERIMENTAL FRESH-WATER ECOSYSTEMS

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

For primary bibliographic entry see Field 5B.  
W82-00595

#### INSECT COMMUNITY STRUCTURE AS AN INDEX OF HEAVY-METAL POLLUTION IN LOTIC ECOSYSTEMS

Miami Univ., Oxford, OH. Dept. of Zoology.  
R. W. Winner, M. W. Boesel, and M. P. Farrell.  
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 647-655, April, 1980. 2 Fig, 6 Tab, 28 Ref.

Descriptors: \*Heavy metals, \*Chironomids, \*Stream pollution index, Copper, Chromium, Zinc, Aquatic insects, Caddisflies, Mayflies, Midges, Water pollution effects, Aquatic populations, Bioindicators, Macroinvertebrates, \*Lotic environment, Insects, Ecosystems.

Measurements of macroinvertebrate populations in two streams of southwestern Ohio suggest that community structure shows a predictable, graded response to pollution by heavy metals. In heavily polluted regions of both streams, only chironomids and tubificid worms survived in rock rubble and riffle sections. Midge larvae predominated in the most polluted areas. The correlation coefficient for percentage of chironomids in relation to copper levels was +0.93. The lowest changes in coefficient of variation (CV) were found at the most polluted stations and increased along a gradient of decreasing metal levels. The number of chironomid species increased as metal pollution levels decreased. Caddisflies were numerically important at points of intermediate pollution along both streams, while mayflies were found only at areas of very low pollution. The percentage of chironomids present in lotic water samples is proposed as a useful index of stream pollution by heavy metals. (Geiger-FRC)  
W82-00596

#### METAL SPECIATION EFFECTS ON AQUATIC TOXICITY

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.  
For primary bibliographic entry see Field 5A.  
W82-00610

#### AN ENVIRONMENTAL SAFETY ASSESSMENT OF BUTYL BENZYL PHthalATE

Monsanto Co., St. Louis, MO.

For primary bibliographic entry see Field 5A.  
W82-00615

#### ENVIRONMENTAL HEALTH HAZARDS

For primary bibliographic entry see Field 5F.  
W82-00625

#### HUMAN HEALTH HAZARDS ASSOCIATED WITH CHEMICAL CONTAMINATION OF AQUATIC ENVIRONMENT

Environmental Protection Agency, Cincinnati, OH.

J. F. Stara, D. Kello, and P. Durkin.  
Environmental Health Perspectives, Vol 34, p 145-158, February 1980. 1 Fig, 7 Tab, 88 Ref.

Descriptors: \*Human diseases, \*Water pollution, Natural waters, \*Chemical wastes, Water quality, Carcinogens, Mutagens, Teratogens, Pharmacokinetics, Risks, Public health, Hazardous materials.

The development of ambient water criteria to protect human health is the focus of this paper. Both human and aquatic health assessments involve extrapolating results of observable responses in test species to projected or acceptable levels in the species of concern. Certain practical differences exist between human and aquatic risk assessment. Human health hazard assessment attempts to convert a risk from various mammalian species to only a single species. Aquatic hazard assessment is concerned with the effect of xenobiotic stress in aquatic communities, groups of species interacting by mechanisms which are neither readily quantified nor clearly understood. Information on sources of exposure, pharmacokinetics, and adverse effects must be carefully evaluated. Source data is essential to determine the contribution of exposure from water relative to all other sources. Pharmacokinetic data allow extrapolation and characterization of the mode of toxic action. Toxic effects information includes data on acute, subchronic and chronic toxicity, mutagenicity, teratogenicity, and carcinogenicity. A distinction must be made between threshold and nonthreshold effects. For carcinogens and mutagens criteria are calculated by postulating an acceptable increased level of risk and using extrapolation models to estimate the dose which would result in these increased levels of risk. For other chemicals, thresholds are assumed and criteria are calculated by deriving acceptable daily intakes. (Baker-FRC)  
W82-00632

#### SEDIMENTS AS A SOURCE OF PHOSPHATE: A STUDY OF 38 IMPOUNDMENTS

Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.

For primary bibliographic entry see Field 2H.  
W82-00633

#### ACIDITY FLUCTUATIONS AT A BROADLAND SITE IN NORFOLK

Ministry of Agriculture, Fisheries, and Food, Norwich (England). Crops Research Lab.

For primary bibliographic entry see Field 2K.  
W82-00656

#### DISTRIBUTION AND BIOLOGICAL AVAILABILITY OF REACTIVE HIGH MOLECULAR WEIGHT PHOSPHORUS IN NATURAL WATERS IN NEW ZEALAND

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.

For primary bibliographic entry see Field 2H.  
W82-00659

#### FACTOR ANALYSIS OF THE IMPACT OF THE ENVIRONMENT ON MICROBIAL COMMUNITIES IN THE TVARMINNE AREA, SOUTHERN COAST OF FINLAND

Zoological Station, Tvarminne (Finland).

P. Vaatanen.  
Applied and Environmental Microbiology, Vol 40, No 1, p 55-61, July, 1980. 2 Tab, 22 Ref.

Descriptors: \*Microbial studies, \*Environmental effects, Populations, Temperature effects, Wind, Seasonal variations, \*Finland, Coasts, Estuarine environments, Brackish water, Seawater, Microorganisms, Rainfall, Coliforms, Wastewater outfalls, Effluents, Bacteria.

Data obtained regarding 10 environmental parameters and 16 microbiological parameters at a sampling station on the Tvarminne Archipelago, Finland, had been subjected to regression analysis in a previous study. In the present study, the correlations between the parameters were factorized using the principal axis solution, and eight of the factors of apparently greatest importance were rotated by the varimax method for the total data and the data for the open-water period. The eight factors selected were characterized by different loadings for water temperature, salinity, ice cover, organic and

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humic matter, microbial counts, transparency, microbial respiration, wind vectors, and rainfall. All of the microbiological parameters aside from H2S producers, proteolytic bacteria, enterococci and yeasts are mainly loaded in one factor. The factors dealing with freshwater outflows cover 50-69% of the variance of fluorescent pseudomonads, bacterial spores, and fecal coliforms. The water temperature factor explains most of the variance of direct counts. A third factor, vernal phytoplankton bloom, not identified by regression analysis, explains most of the variance of the respiration parameters. These three factors, plus the periods before and after the bloom, covered about 90% of the factor variance in the populations and also the major part of the variance of most microbiological parameters. The west winds, summer rains, and early winter factors did not contribute much to the factor variances, but the parameters contributing to them are still needed for satisfactory interpretation of the factors. Although much of the information provided by factor analysis was the same as that of regression analysis, the environmental processes affecting microbes were easier to identify with the factor analysis than with regression analysis. (Baker-FRC)

W82-00672

#### ANNUAL SUCCESSION OF PHYTOPLANKTON IN ONE HEATED POND IN CENTRAL FINLAND, Jyväskylä, Univ. (Finland). Dept. of Biology. P. Eloranta. Acta Hydrobiologica, Vol 22, No 4, p 421-438, 1980. 10 Fig, 4 Tab, 13 Ref.

Descriptors: \*Phytoplankton, \*Cooling ponds, \*Seasonal variation, Cooling water, \*Temperature effects, Thermal pollution, Water quality, Primary productivity, Biomass, \*Finland.

Seasonal fluctuations of phytoplankton biomass and the structure of communities were determined in a pond used to cool one small thermal power plant. The following were monitored: water quality, primary production in situ and in vitro in different temperatures, periphyton on artificial substrates, and zooplankton. The phytoplankton reached a maximum in March of 10.3 gm/cu m, primarily comprising cryptophytes and Asterionella gracilima Heib. The autumn maximum of 11.2 gm/cu m was in September and was made up of Cyclotella meneghiniana Kutz. Green algae were dominant in spring and summer. The biomass minimum in the darkest winter season was less than 0.2 gm/cu m. The chlorophyll alpha concentration of the phytoplankton fresh weight biomass averaged 0.34%. The Shannon diversity was calculated with natural logarithms, and on the basis of each species amounted to 2.5 to 2.9 in summer and 2.7 to 2.8 in winter. There was no significant correlation between Shannon diversity and the logarithm of the phytoplankton biomass. (Small-FRC)

W82-00673

#### EFFECT OF OTTER PRAWN TRAWLING ON THE MACROBENTHOS OF A SANDY SUBSTRATE IN A NEW SOUTH WALES ESTUARY, New South Wales State Fisheries, Sidney (Australia). P. J. Gibbs, A. J. Collins, and L. C. Collett. Australian Journal of Marine and Freshwater Research, Vol 31, No 4, p 509-516, 1980. 5 Fig, 3 Tab, 19 Ref.

Descriptors: \*Estuarine environment, \*Benthic environment, \*Trawling, Benthos, Estuaries, Environmental effects, \*Ecological effects, Substrates, Benthic fauna, Sediments, Crustaceans, Fishing industry, New South Wales, \*Australia.

Recreational fishermen along the New South Wales coast in Australia have made persistent claims that estuarine otter prawn trawling by commercial fishermen kills benthic organisms, depriving fish species of their food source. This study made a quantitative assessment of the effect of commercial prawn trawling in New South Wales on the macrobenthos of the trawl grounds and made a visual assessment of the operation of com-

mercial nets and otter boards underwater. Macrofauna at three treatment sites and one control site were sampled on three occasions: before and after intensive trawling, prior to the opening of the commercial prawning season, and at the close of the commercial prawning season. Divers made underwater observations of the otter trawl nets in operation. Numerical clustering techniques were used as a preliminary step to statistical comparisons of the number of individuals, number of species, and species diversity at the four sites. The underwater observations revealed that the effect on the sea bottom and the macrofauna was minimal when the prawn trawls were operating efficiently. Very little sand was disturbed and the sea bottom appeared only slightly marked by the trawl's passage after repeated trawls. The differences between sites demonstrated by the classificatory analysis and community statistics were thought to be due to the patchiness in distribution generally associated with benthic animals and differences in sediment types at the sites, rather than with the trawling. It was concluded that the otter prawn trawling, as conducted in most estuaries in New South Wales, causes no detectable alterations in the macrobenthic fauna of the trawl grounds. (Carroll-FRC)

W82-00674

paper mills had more adverse effect on fish flavor than did effluents from the mills. The fish survey identified 1594 fish representing 24 species. Macroinvertebrate species have shown a clear shift from pollution-tolerant species to pollution-intolerant species over the course of the study, which has been conducted annually since 1962. These improvements in biological and water quality status correspond with construction of effluent treatment facilities at the paper mills during the 1970's. (Cassar-FRC)

W82-00688

#### THE CHANGING STATUS OF REEDSWAMP IN THE NORFOLK BROADS,

Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.

L. A. Boorman, and R. M. Fuller.

Journal of Applied Ecology, Vol 18, No 1, p 241-269, April, 1981. 7 Fig, 8 Tab, 67 Ref.

Descriptors: \*Wetlands, \*Vegetation, \*Distribution patterns, Swamps, Marshes, \*Reedswamp, Rodents, Coots, Geese, Eutrophication, Grazing, Norfolk Broads, Succession, Water pollution effects, Ecological effects, Lakes, \*England.

Changes in the distribution and area of reedswamp (vegetation of various tall immersives graminoids growing where the normal summer water table is above the substratum) from 1880 to the present were documented by Ordnance Survey maps and aerial photographs of the Norfolk Broads. Between 1880 and 1960 reedswamp increased from 216.5 ha to 244.6 ha. Starting in 1905 the reedswamp area decreased steadily to the present 1977 level of 49.2 ha. Prior to 1946, losses were from succession to fern; after 1946, from regression to open water. A major factor in the decline of the reedswamp was grazing by the coypu (*Myocaster coypus Molina*), a large South American wetland rodent which escaped from fur farms by 1936 and became well established during the 1940's. The population reached a height of about 70,000 in 1962 and presently numbers about 15,000. Feral geese are now actively limiting reedswamp in some areas. Eutrophication appeared to have no direct effects on reedswamp, but increased sedimentation rates can make the reeds, especially the shoots, more available for grazing. Neither soil type or boat traffic were responsible for the reedswamp changes. (Cassar-FRC)

W82-00691

#### 1980 ANNUAL REPORT, COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY,

International Joint Commission—United States and Canada, Windsor (Ontario).

1980, 34 p. 3 Tab, 11 Ref.

Descriptors: \*Lakes, \*Toxicity, \*Water quality, \*Hazardous materials, \*Viruses, Epidemiology, Fish populations, Fish diseases, Aquatic populations, Enteroviruses, Toxins, \*Great Lakes.

This report summarizes the 1979-80 activities of the Committee on the Assessment of Human Health Effects of Great Lakes Water Quality. High priority was placed on evaluating the health hazards of chemicals identified in the Great Lakes ecosystem. Also investigated were viruses in the Great Lakes, the development of compatible cancer registries within the Great Lakes Basin, and levels of contaminants in fish. The committee attempted a study of the health hazards of 381 compounds but found that toxicological and exposure data on the chemicals were insufficient for a meaningful evaluation. Additional toxicology and exposure studies of potentially hazardous chemicals are recommended. Results of an investigation of enteric viruses indicated that water quality standards for Great Lakes water are successfully preventing these viruses from being spread via the public water supply. However, the development of more sensitive indicators of the presence of viruses is recommended, as well as better data on the relationship between water treatment processes and the fate of water-borne viruses. The Committee also recommended that: (1) additional fish surveillance studies be carried out to assess 'real time'

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exposures of man, and to assess the effectiveness of contaminant control strategies; and (2) a workshop be held on the compatibility of Great Lakes Basin cancer registries, as a prelude to a proposed cancer morbidity and mortality survey of the countries bordering Lake Ontario. Also suggested is a workshop on the interaction of toxic chemicals in the Great Lakes ecosystem. (Garrison-Omniplan) W82-00706

#### 1980 ANNUAL REPORT - A PERSPECTIVE ON THE PROBLEM OF HAZARDOUS SUBSTANCES IN THE GREAT LAKES BASIN ECO-SYSTEM,

International Joint Commission—United States and Canada, Windsor (Ontario). November, 1980. 70 p. 10 Tab, 20 Ref, 1 Append.

Descriptors: \*Lake basins, \*Contaminants, \*Waste water disposal, \*Chemical wastes, \*Polychlorinated biphenyls, Eutrophication, Halogens, Residual chlorines, Sediments, Sludge, Aquatic populations, Human populations, Suspended solids, Trace metals, Potable water, Chlorine, \*Great Lakes basin, Ecosystems.

The infusion of synthetic industrial chemicals has increased exponentially in the Great Lakes ecosystem, particularly in the last 40 years. Some of these chemicals may be toxic. This report discusses these substances relative to biological and human health effects, transport and fate, sources, and control alternatives, and presents a plan for attacking the problems. Effects on human health are often not readily distinguishable; those on aquatic life are more easily seen. Two main sources of human exposure are through drinking water and eating fish. No conclusions have been drawn concerning the health effects of the water quality. One study examined the correlation between PCB residues in Lake Michigan fish and concentrations of PCBs in the blood of those eating the fish. Higher levels were found in those eating large amounts of fish. Hazardous substances in large lakes, such as DDT, dieldrin, mirex, PCBs, phthalates, and mercury, are persistent in the water, sediment, and biota and will be widely dispersed through the lakes. Hazardous substances enter the Great Lakes through emissions to the atmosphere, industrial and municipal wastewater discharges, urban and rural land runoff, and other sources such as spills and leaching from solid waste disposal sites. Recommendations to reduce the problem of hazardous substances include reuse and treatment technologies, reducing the loss or use of substance that enter the air or water effluents, identifying high-exposure populations, establishing tolerance levels for toxic substances, and centralizing an information system for data on hazardous substances. (Atkins-Omniplan)

W82-00707

#### 1980 REPORT ON GREAT LAKES WATER QUALITY - APPENDIX,

International Joint Commission—United States and Canada, Windsor (Ontario). November 12, 1980. 82 p. 14 Fig, 17 Tab.

Descriptors: \*Lake rehabilitation, \*Eutrophic lakes, \*Water quality, \*Phosphorus removal, \*Algal growth, Algal blooms, Fish populations, Fish conservation, Aquatic populations, Fish diseases, Aquatic environment, Water quality data, \*Great Lakes ecosystem.

This appendix was developed to assist the Great Lakes Water Quality Board in preparing its report to the International Joint Commission. Water quality status in the Great Lakes ecosystem is presented with a review of municipal phosphorus control programs. Also included is a brief summary of the development and implementation of data quality assurance programs with specific reference to interlaboratory comparisons. Municipal phosphorus loads are presented on a lake-by-lake basis. Municipal treatment plants are ranked according to the difference between their actual annual phosphorus load and their estimated load at an effluent phosphorus concentration of 1 milligram per liter. A special section on Aquatic Ecosystem Quality reviews the progress in eutrophication control and

the decreased residue levels of contaminants observed in several fish species in the lower lakes as well as in gull eggs collected throughout the basin. PCB levels in gull eggs in Lake Superior have exhibited little change, possibly reflecting the importance of atmospheric inputs. Three new problem areas have been identified in the Great Lakes Basin: Marquette and Munising bathing beaches on Lake Superior, which exceeded state fecal and total coliform objectives, and White Lake on Lake Michigan, which was added to the problem area list because of organics found in water, sediments, and fish. (Garrison-Omniplan) W82-00708

#### ACUTE TOXICITY OF ZINC TO SOME FISHES IN HIGH ALKALINITY WATER,

Illinois State Water Survey, Urbana. P. Reed, D. Richey, and D. Roseboom. Illinois Institute of Natural Resources, Circular 142, 1980. 21 p. 4 Fig, 5 Tab, 48 Ref, 2 Append.

Descriptors: \*Fish populations, \*Toxicity, \*Zinc, \*Alkaline water, \*Fish toxins, Poisons, Catfish, Bluegills, Bass, Hazardous materials, Mud-water interfaces, Alkalinity, Water pollution effects, Water pollution sources.

The alkalinity of lakes and streams in Illinois are variable, with concentrations, as calcium carbonate, generally exceeding 200 mg/l in the northern and central part of the state and often less than 100 mg/l in the southern part. This study documents the acute toxic effects of varying concentrations of zinc on certain fishes native to Illinois. Fourteen-day bioassays were performed with bluegill fry, channel catfish fingerlings, and largemouth bass fingerlings in waters relatively high in the salts of calcium and magnesium, with correspondingly high alkalinity. The levels of total zinc in natural water bodies in Illinois generally do not exceed 0.5 mg/l. Soluble zinc concentrations are usually less than 0.05 mg/l, except in those surface waters that are significantly influenced by urban centers. Elevated concentrations of zinc occur at the mud-water interface, during anaerobic conditions, in Illinois lakes. The concentrations thus far observed are generally two to three times higher than those detected in the overlying waters. The 14-day median tolerance limit at 20 degrees Celsius was 11.0 mg/l soluble zinc for the bluegill, 8.2 mg/l soluble zinc for the channel catfish, and 8.0 mg/l soluble zinc for the largemouth bass. For protection of the fishes investigated, and in compliance with Illinois water pollution regulations, soluble zinc concentrations in Illinois streams having alkalinity and hardness should not exceed 0.8 mg/l. (Garrison-Omniplan) W82-00708

#### DOES IMPROVED WASTE TREATMENT HAVE DEMONSTRABLE BIOLOGICAL BENEFITS,

Virginia Polytechnic Inst. and State Univ., Blacksburg, Center for Environmental Studies. H. H. Seagle Jr., A. C. Hendricks, and J. Cairns Jr. Environmental Management, Vol 4, No 1, p 49-56, January, 1980. 3 Fig, 4 Tab, 22 Ref.

Descriptors: \*Textile mill wastes, \*Water quality control, \*Effluents, Industrial wastes, \*Wastewater treatment, Aquatic habitats, Water pollution effects, Water pollution control, Invertebrates, Fish, Zinc, Toxicity, Benthic fauna, Diversity indices, Shenandoah River, \*Ecological effects.

Ten benthic surveys and 9 static fish bioassays were conducted since 1972 on the South Fork of the Shenandoah River near the Avtex rayon and polyester fiber plant at Fort Royal, Virginia. Prior to construction of an activated sludge treatment system in February 1974, zinc and BOD<sub>5</sub> inputs averaged 239 and 733 kg per day, respectively. The benthic community, especially on the right side of the river, where the effluent was channeled, had low diversity values (0.2-4.2) and reduced numbers of taxa and organisms compared with the upstream control. A fish bioassay showed that the effluent was acutely toxic at an admixture of 34.5% with river water. While water chemistry and temperature were little affected by the improved waste

treatment facilities, levels of Zn and BOD<sub>5</sub> were significantly reduced and the aquatic habitat improved. The plant's treated effluent contained 70% less BOD<sub>5</sub> and 60% less zinc. In 1974 the effluent was toxic to fish at 80% concentration, but it was more toxic after that. Diversity values for fauna increased to 1.19-3.39. Taxa and numbers of organisms increased. Only during drought conditions in 1976 and 1977 did the improved situation regress. Although the benefits of pollution control were clearly demonstrated, complete recovery of the river is unlikely, particularly in areas where the effluent is channeled and at low flow conditions. (Cassar-FRC) W82-00709

#### THE RELATIONSHIP OF ENVIRONMENTAL EPIDEMIOLOGY TO WATER AND WASTEWATER PLANT OPERATORS,

Oklahoma State Dept. of Health, Oklahoma City. D. Farley. Southwest and Texas Water Works Journal, Vol 63, No 3, p 10, 12, June, 1981.

Descriptors: \*Epidemiology, \*Water pollution effects, \*Wastewater treatment, Water treatment, Public health, Toxicity, Legislation, Regulations, Legal aspects, Oklahoma State Department of Health, \*Wastewater plant operators, Personnel.

Water and wastewater treatment plant operators should be aware of the potential health effects of each step in the processes. The Oklahoma State Department of Health is attempting to apply the concept of epidemiology to this field. The short term acute effects of pollutants in drinking water or renovated wastewater are quickly handled, but chronic, long term effects may be discerned only by epidemiological analysis. (Cassar-FRC) W82-00709

#### EFFECTS OF HYPOLIMNETIC DISCHARGE ON FISH HEALTH BELOW A RESERVOIR,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures. J. M. Grizzel.

Transactions of the American Fisheries Society, Vol 110, No 1, p 29-43, January, 1981. 1 Fig, 3 Tab, 106 Ref.

Descriptors: \*Sublethal effects, \*Fish, \*Hypolimnetion, Thermal stratification, \*Thermal pollution, Temperature effects, Trout, Perch, Buford Dam, Georgia, Infection, Pathology, Metals, Reservoirs, \*Reservoir releases.

Dams often cause changes in the impounded stream or river which have important effects on their fish populations. The release of anoxic, hypolimnetic waters, which often contain dissolved manganese, iron, ammonia, hydrogen sulfide, and other chemicals, from impoundments may increase the downstream concentrations of these substances. Rainbow trout, brown trout, brook trout, and yellow perch from two locations in the tailwater from the Buford Dam, in Georgia, and trout from a hatchery which used the tailwater as a water supply were examined for infections, lesions, and liver metal concentration. The fish were found to be infected by 9 genera of parasites, 19 bacteria species, and 1 virus species. Many of the fish that did not have bacterial infections were found to have microscopic lesions in the gills, liver, spleen, and trunk kidney. The occurrence of lesions indicating exposure to a toxicant was related to increases in iron and manganese concentrations, but not to copper concentrations. While manganese did not indicate exposure to high levels of these metals. Since the tailwater contained copper, zinc, iron, manganese, and dissolved oxygen concentrations considered possibly harmful to fish, acclimation may have allowed survival of the fish in the river. The release of hypolimnetic water from the impoundment resulted in low pH, low dissolved oxygen concentrations, low oxidation-reduction potential, and high metal concentrations. Water characteristics, acclimation by the fish, and possible synergistic activity make most bioassay data unreliable for the prediction of the toxicity of tailwaters. (Carroll-FRC) W82-00805

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#### THE EFFECT OF SEASON AND LOCATION ON PHOSPHOADENYLATE CONCENTRATIONS AND ADENYLATE ENERGY CHARGE IN TWO SPECIES OF FRESHWATER CLAMS, Savannah River Ecology Lab., Aiken, SC.

For primary bibliographic entry see Field 2H.

W82-00810

#### POTENTIAL EUTROPHICATION OF THE RIDEAU RIVER BY AN URBAN DRAINAGE WATERWAY,

MacLaren (J. F.) Ltd., Willowdale (Ontario).

M. H. Habicht, K. Adamowski, and A. C.

Middleton.

Canadian Journal of Civil Engineering, Vol 8, No 2, p 165-172, June, 1981. 4 Fig, 8 Tab, 9 Ref.

Descriptors: \*Eutrophication, \*Predictions, \*Water management, Management planning, Bioassay, Chemical properties, Storm water, Dam effects, Environmental effects, Nutrients, Algae, Biomass, \*Urban watersheds, Industrial wastes, Lumber industry, \*Saw mills.

Agricultural activities and industrialization promote natural nutrient enrichment, nuisance blooms of algae, depletion of dissolved oxygen, increased turbidity, and changes in aquatic communities, which lead to eutrophication. A study of the eutrophication potential of an urban drainage waterway (Saw Mill Creek) on the Rideau River in Ottawa was designed to determine the usefulness of a combination of bioassay and chemical characterization for estimating the eutrophication potential of storm water and to investigate possible effects of two storm water management alternatives on eutrophication potential. Samples were collected from the creek and the river during eight different peak storm flow conditions. Although nutrient concentrations were found to increase during storm flows, peak flow concentrations of total phosphorus and nitrogen averaged only 0.190 and 2.5 milligrams per liter, respectively. Saw Mill Creek had no significant effect on algal growth in the Rideau River at nutrient addition ratios of 5 percent or less, which probably includes most dry weather flows. However, bioassays produced significantly different algal standing biomass at 10 and 20 percent nutrient addition levels, indicating that the creek can have statistically significant effects on the algal growth in the river during peak flow conditions, when both nutrient concentrations and flow ratios are high. Algal bioassays were shown to be a valuable technique in analysis of the eutrophication of a receiving water by urban drainage water. Simulation of alum treatment of the creek using a jar test did not result in significant reductions in algal growth when compared to that at any of the nutrient addition levels. A reduction in the volume of storm flows of the creek could significantly affect algal growth in the river, however. (Carroll-FRC)

RELATIONSHIPS BETWEEN WATER CHEMISTRY AND RESPIRATION RATE IN SEVERAL POPULATIONS OF LYMPNÆA PEGREGRINA MULLER (GASTROPODA:MOLLUSCA),  
For primary bibliographic entry see Field 2K.  
W82-00854

#### CONVERSION OF ABIENOL INTO TETRAHYDROPEIMANOOL BY ANAEROBIC PROCESSES IN WOODROOM DEBARING EFFLUENT,

British Columbia Research Council, Vancouver.

A. B. McKague, and E. G-H. Lee.

Journal of Chemical Technology and Biotechnology, Vol 30, No 5, p 263-265, 1980. 5 Ref.

Descriptors: \*Anaerobic conditions, \*Abienol, \*Wood wastes, Terpenes, Fish, Toxicity, Chemical reactions, Fate of pollutants, Tetrahydropeimanol, \*Fish toxins, Organic compounds, Industrial wastes, Microbial degradation.

During a study of softwood woodroom debarking effluents toxic to fish, a sample was delayed in transit for three weeks. When retrieved and analyzed, this sample contained less than 1 mg per cu

dm abienol and 13-epimanoool, but contained 12 mg per cu dm of tetrahydropeimanol, which is more toxic to fish than the starting compounds. The conversion was duplicated in the laboratory by anaerobic conversion of abienol in samples of woodroom effluent. Microscopic examination of the effluent indicated the presence of a mixed culture of actively motile bacteria. (Cassar-FRC)

W82-00860

#### EFFECTS OF THERMAL EFFLUENTS ON COMMUNITIES OF BENTHIC MARINE MACROALGAE,

University of Southern California, Los Angeles.

J. S. Deviny.

Journal of Environmental Management, Vol 11, No 3, p 225-242, November, 1980. 2 Fig, 5 Tab, 39 Ref.

Descriptors: \*Algae, \*Thermal pollution, \*Powerplants, Macrophytes, Benthic flora, Effluents, Marine algae, Humboldt Bay, \*California, Punta Banda, Mexico, Plant communities, Species diversity, Species composition, Temperature effects.

Marine benthic macroalgae were studied in three sites with thermal water. Two study areas (Humboldt Bay, northern California, and near Long Beach, southern California) received thermal effluents from powerplants, and the third, Punta Banda, Mexico, had no powerplant discharge but a natural thermal gradient in a shallow bay with restricted circulation. Ordination analysis of the algal communities showed that a 10% change in species composition occurred for each degree of temperature up to 3°C, but numbers were not reduced. Temperatures 7°C above ambient eliminated large macrophytes. Populations of brown algae were reduced or eliminated, and green algal species were a larger proportion of the community. Temperatures 10°C above ambient left ephemeral communities low in diversity. (Cassar-FRC)

W82-00870

#### EFFECTS OF A CATTLESKIN TANNERY STREAM QUALITY AND BENTHIC MACROINVERTEBRATES IN CENTRAL MAINE,

Maine Univ. at Orono. School of Forest Resources.

R. L. Duval, C. R. Ferris, R. B. Owen, K. E.

Gibbs, and L. K. Fink.

Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 269-276, 1980. 1 Fig, 4 Tab, 6 Ref.

Descriptors: \*Water pollution, \*Industrial wastes, \*Benthic fauna, \*Streams, Heavy metals, Benthos, Wastewater treatment, Sulfuric acid, Chromium, Flow discharge, Environmental effects, Sediments, Water sampling, Turbidity, \*Tannery wastes, Conductivity, Substrates, \*Marine, Ecological effects

The effects of a cattle skin tannery on stream quality and benthic macroinvertebrates in central Maine are discussed. Water quality measurements were made at monthly intervals during the summer months at five locations along a river which receives tannery waste. Sediment samples were collected, and the effects of the effluent and accumulation of heavy metals were determined. A distinct reduction in water and substrate quality was evident in June, coinciding with the period of lowest streamflow. The benthic invertebrate community was affected in two ways. The number of taxa was reduced by 60%, and the diversity and distribution of taxa at the collection sites were altered. The number of invertebrates samples for heavy metals was too small to permit drawing conclusions. However, the concentrations of metals found in those sampled approached lethal levels. Contamination was greatest for chromium. (Titus-FRC)

W82-00872

#### FACTORS CONTROLLING PHYTOPLANKTON PRIMARY PRODUCTIVITY IN BYRAM LAKE, MT. KISCO, N.Y., SUMMER, 1977,

Fordham Univ., Bronx, New York. Louis Calder Conservation and Ecology Study Center.

For primary bibliographic entry see Field 2H.

W82-00915

INFLUENCE OF PHOSPHORUS LOADS AND OF SOME LIMNOLOGICAL PROCESSES ON THE PURITY OF LAKE WATER,  
Polish Academy of Science, Warsaw. Inst. of Ecology.

For primary bibliographic entry see Field 2H.

W82-00923

#### MACROBENTHOS OF PINE ISLAND BAYOU IN THE BIG THICKET NATIONAL PRESERVE, TEXAS,

Lamar University, Beaumont, TX. Dept. of Biology.

R. G. Darville, and R. C. Harrel.

Hydrobiologia, Vol. 69, No 3, p 213-223, March, 1980. 1 Fig, 5 Tab, 27 Ref.

Descriptors: \*Water quality, \*Benthic fauna, \*Streams, \*Pine Island, \*Texas, Big Thicket National Preserve, Species diversity, Biological communities, Water pollution effects, Seepage, Brines, Oil.

Water quality was generally good at 7 stations on Pine Island and Little Pine Island bayous of south Texas, according to surveys conducted June 1977 to May 1978. Seepage of brines from nearby oil fields was revealed by higher Cl and conductivity values at four stations. The higher chloride content (up to 1440 ppm) improved stream conditions by flocculation of suspended solids and reducing turbidity. BOD was relatively low, 0.1-10.4 ppm per liter. Dissolved oxygen ranged from 0.8 ppm in small isolated pools to 12.2 ppm. Carbon dioxide concentrations generally decreased downstream. pH was lowest at the upper stations (4.2-7.4) and highest (3.4-7.8) near the sewage effluent outlet. Turbidity ranged from 20 to 395 JTU. Orthophosphates and nitrates were highest near the effluent outfall. The highest chlorophyll a concentration measured was 0.2948 mg per liter. Dominant benthic fauna were oligochaetes (62.3%) and chironomids (22.5%). The intolerant mayfly Hexagenia limbata was found at all stations except below the sewage outfall. The number of taxa found varied from 71 at the station with lowest turbidity to 43 below the effluent discharge. The highest annual diversity, 3.82, was found at the station with lowest turbidity. All other stations had diversity values of 2.57 to 3.09, indicating moderately stressed communities. (Cassar-FRC)

W82-00924

#### THE EFFECTS OF HEAVY METALS ON MICROBIAL BIOMASS IN SEDIMENTS OF PALESTINE LAKE,

Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.

C. E. Nugent, G. J. Atchison, D. W. Nelson, and A. W. McIntosh.

Hydrobiologia, Vol 70, No 1/2, p 69-73, April, 1980. 2 Fig, 4 Tab, 20 Ref.

Descriptors: \*Heavy metals, \*Sediments, \*Metal finishing wastes, Biomass, Microorganisms, Metals, Zinc, Chromium, Cadmium, \*Palestine Lake, Indiana. Lake sediments, Lakes, Water pollution effects, Microbial degradation, Degradation, Organic matter, \*Eutrophic lakes.

Palestine Lake, Indiana, a highly eutrophic lake which receives chromium, cadmium, and zinc from an electroplating plant, showed suppression of organic decomposition and low microbial biomass in the most contaminated sediment, averaging metal concentrations (micrograms per g dry weight) of 17,840 Zn, 4380 Cr, and 585 Cd. Adenosine triphosphate (ATP) concentrations and microbial colony numbers on pour plates were used as biomass indicators. The highly contaminated area had 3.7 million mean microbial colonies in 1 g sediment; the less contaminated sites had 27-62 million. ATP concentrations were 2.9 times 10 to the minus 4.5-7.6 times 10 to the minus 7th power in the highly contaminated area and 4.5-7.6 times 10 to the minus 7th power in the less contaminated sites. (Cassar-FRC)

W82-00925

#### AN ALTERNATIVE WASTEWATER DISINFECTANT,

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Maryland Environmental Service, Annapolis.  
For primary bibliographic entry see Field 5D.  
W82-00950

BIOCONCENTRATION OF PESTICIDES BY EGG MASSES OF THE CADDISFLY, TRIANODES TARDUS MILNE, Illinois Natural History Survey, Urbana.  
For primary bibliographic entry see Field 5B.  
W82-00982

SEA URCHIN SPERM BIOASSAY FOR SEWAGE AND CHLORINATED SEAWATER AND ITS RELATION TO FISH BIOASSAYS, Washington Univ., Seattle. Fisheries Research Inst.  
For primary bibliographic entry see Field 5A.  
W82-00988

EXPERIMENTAL MANIPULATION OF ALgal BLOOM COMPOSITION BY NITROGEN ADDITION, Department of Fisheries and Oceans, Winnipeg (Manitoba).

J. Barica, H. Kling, and J. Gibson. Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1175-1183, July, 1980. 4 Fig, 3 Tab, 15 Ref.

Descriptors: \*Eutrophication, \*Fishkill, \*Algal control, \*Species composition, \*Nitrogen, Nutrients, Nitrate, Algal growth, Biomass, Aquatic productivity, Primary productivity, Ammonium, Cyanophyta, Chlorophyta, Ponds.

The nutrient contents of a small prairie lake and a pond which has experienced seasonal anoxia as a result of collapses of *Aphanizomenon flos-aquae* blooms were experimentally manipulated to see if changes in phytoplankton composition rather than pesticides could be used to control summerkill. Ammonium, nitrate or both were added to the prairie lake in enclosures and to the whole pond over an 8 to 12-wk period. When nitrogen was added prior to the appearance of *A. flos-aquae*, the bloom magnitude and species composition of the algae were altered. The biomass of this alga was reduced when low level additions (0.75-1.5 g/cu m/wk) of nitrogen were added after the appearance of cyanophyte blooms. With high nitrogen additions (7-14 g/cu m/wk), cyanophytes disappeared and small chlorophytes and cryptomonads dominated. In the absence of *A. flos-aquae*, the fishkill did not occur. High additions of nitrogen caused significant nitrate residues in the water. Without nutrient supplements, both the lake and pond returned to heavy *A. flos-aquae* blooms and fishkills the following summer. (Geiger-FRC)  
W82-00998

A RAPID SIMPLE LONG-TERM TOXICITY ASSAY FOR AQUATIC CONTAMINANTS USING THE NEMATODE PANAGRELLUS RE-DIVIVUS, Manitoba Univ., Winnipeg. Dept. of Zoology. For primary bibliographic entry see Field 5A.  
W82-01017

THE ACTIVITY OF ENVIRONMENTAL SAMPLES IN A CELL CULTURE TEST FOR ASBESTOS TOXICITY, Naylor Dana Inst. for Disease Prevention, Valhalla, NY.  
B. Reiss, J. R. Millette, and G. M. Williams. Environmental Research, Vol 22, No 2, p 315-321, August, 1980. 2 Tab, 21 Ref.

Descriptors: \*Asbestos, \*Drinking water, Potable water, \*Toxicity, Culturing techniques, Cultures, Carcinogens, Particulate matter.

Six coded samples of particulate matter were provided by the United States Environmental Protection Agency for use in tests designed to assay the toxic potential of the samples through the inhibition of colony-forming efficiency of cultured human embryonic intestine-derived epithelial (L-407) cells. The samples were: (1) particulates fil-

tered from Duluth, Minnesota drinking water, known to contain amphibole crystals, red clay, and biological fragments; (2) particulates from Seattle, Washington drinking water, containing chrysotile asbestos; (3) particulates filtered from San Francisco, California drinking water, containing chrysotile asbestos; (4) a sample of less than 2 micrometer size fraction of taconite tailings prepared by a sedimentation separation procedure; (5) a sample of attapulgite clay, a nonasbestos mineral consisting of fibers of the same or smaller diameter range as chrysotile asbestos; (6) amosite fibers used to study the effects of ingested asbestos on rats and hamsters. The results of the assay indicated that the most toxic of the samples was amosite. The toxicities of the particulates from drinking water were about 100-fold less than that of amosite. The order of toxicity of the drinking water particulate samples decreased from San Francisco, to Seattle, to Duluth. Samples of attapulgite clay and taconite tailings displayed about half the toxicity of the drinking water particulates. These results indicate that this assay provides a sensitive and accurate method for screening asbestos and asbestosiform contamination for potential toxicity. (Baker-FRC)  
W82-01031

#### UPTAKE AND TRANSFER OF THE CHLORINATED HYDROCARBON LINDANE (GAMMA-BHC) IN A LABORATORY FRESHWATER FOOD CHAIN,

Hamburg Univ. (Germany, F.R.) Inst. fuer Hydrobiologie und Fischereiwissenschaft. P. D. Hansen. Environmental Pollution, (Series A) Vol 21, No 2, p 97-108, February, 1980. 4 Fig, 14 Ref.

Descriptors: \*Lindane, \*Food chain, \*Accumulation, Daphnia, Algae, Chlorella, Stickleback, \*Fish, Insecticides, Pesticides, Fate of pollutants, Adsorption, Chlorinated hydrocarbons.

The uptake, transfer, and accumulation of lindane ( $\gamma$ -BHC) was studied in a freshwater food chain consisting of Chlorella sp., the primary producer; *Daphnia magna*, Consumer 1; and the stickleback, *Gasterosteus aculeatus*, Consumer 2. The algae used had an accumulation factor of 749 from a medium containing 10 micrograms per liter lindane. Total accumulation factors for the other 2 links in the food chain were: *Daphnia*, 66.8; and fish, 118.6. A model was developed showing the lindane accumulated by each consumer during 50 days feeding in water with 10 micrograms per liter lindane. Adsorption from water was essentially complete within 1 to 3 days while accumulation from food continued to increase. Laboratory *Daphnia* accumulated far more lindane than free-living *Daphnia*. The sublethal concentrations of lindane caused irritation and a 50% reduction in reproduction rate in *Daphnia*. Fish rapidly approached the equilibrium concentration. After 9 days, 67% of the total lindane was found in the fish, with large amounts in gills, stomach, liver, and gut. Female sticklebacks took up more lindane than males; males in breeding condition had an accumulation factor 5.8 times larger than those in normal condition. (Cassar-FRC)  
W82-01033

#### ASSESSMENT OF WATER QUALITY CONDITIONS IN SKAMOKAWA CREEK, WASHINGTON,

Washington State Dept. of Ecology, Olympia. D. Norton. Document DOE 81-7, February, 1981. 16 p, 3 Fig, 3 Tab, 20 Ref.

Descriptors: \*Water quality standards, \*Coliforms, \*Streams, \*Feces, Cattle, \*Bacteria, Contamination, On-site data collections, Benthic environment, Fish populations, Spawning, Dissolved oxygen, Skamokawa basin, \*Washington.

A sanitary survey was conducted to determine water quality conditions in the Skamokawa basin, located in Wahkiakum county in Washington. Skamokawa Creek is a small tributary of the lower Columbia River Basin. The creek met all criteria for Class A waters in the state with the exception of fecal coliforms. Skamokawa Creek was in violation

of the Class A standard with a median value of 200 organisms per 100 ml with 50 percent of the samples exceeding 200 organisms per 100 ml. The high fecal coliform levels most likely result from the proximity to the creek of older homes, many of which discharge directly into the creek. This proximity prevents adequate buffering between the drain fields of the residences and the creek. In addition, cattle access is virtually unrestricted throughout most of the area. Contamination from dairy cattle could be expected to increase during the rainy season when runoff from adjacent pastures increases. Fourteen sampling stations were established, and water samples were collected for laboratory analysis of fourteen components. Physical and chemical factors analyzed were pH, total alkalinity, specific conductivity, turbidity, total suspended solids, and nutrients. Bacteriological and biological factors were also studied. Skamokawa Creek appears to be quite suitable for fish passage and spawning success, except when very heavy spawning is combined with unusually low dissolved oxygen concentrations. Dissolved oxygen concentrations during the survey were well within the acceptable limits for fish survival. Overall, it appears that the benthic community in Skamokawa Creek has been only slightly to moderately impacted. (Garrison-Omniplan)  
W82-01066

#### WILSON CREEK DRAINAGE - SURFACE AND GROUND WATER QUALITY, JULY 1978 TO JULY 1979.

Washington State Dept. of Ecology, Olympia. For primary bibliographic entry see Field 5B.  
W82-01069

#### THE EFFECT OF CONTINUOUS ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE ON THE TROPHIC STATUS OF LONG LAKE, WA DURING 1979.

Eastern Washington Univ., Chemey. Dept. of Biology. For primary bibliographic entry see Field 2H.  
W82-01070

#### AN ASSESSMENT OF THE TROPHIC STATUS OF DEER, LOON, AND DIAMOND LAKES, Washington State Dept. of Ecology, Olympia. For primary bibliographic entry see Field 2H. W82-01072

#### CHLORINATED HYDROCARBONS AS A FACTOR IN THE REPRODUCTION AND SURVIVAL OF LAKE TROUT (SALVELINUS NAMAYCUS) IN LAKE MICHIGAN.

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab. Technical Papers of the U.S. Fish and Wildlife Service, No 105, 1981. 44 p, 6 Fig, 18 Tab, 136 Ref.

Descriptors: \*Trout, \*Lake Michigan, \*DDE, \*Polychlorinated biphenyls, \*Toxicity, \*Mortality, Growth, Pesticide residues, Metabolism, Chlorinated hydrocarbons, Aroclors, Water pollution effects, Fish behavior, Fish food, Growth stages.

Although lake trout were considered extinct in Lake Michigan by the mid 1950's, control of the sea lamprey and restocking resulted in an abundance of hatchery-produced lake trout in the lake by the early 1970's. However, no naturally produced yearling or older lake trout have been found in the lake. Studies were carried out on the performance and survival of fry hatched from eggs of Lake Michigan lake trout and exposed for 6 months to PCB's (Aroclor 1254) and DDE at concentrations similar to those present in offshore waters and zooplankton (1.0 ng/l PCB's and 1.0 ng/l DDE in water; 1.0 micro g/g PCB's and 0.1 micro g/g DDE in food) and at concentrations 5 and 25 times higher. Cumulative mortality of the fry exposed to simulated Lake Michigan levels of PCB's and DDE for 6 months was 40.7%, nearly twice that of unexposed (control) fry, and mortality at the highest exposure level was 46.5%. Evaluation of the growth, swimming performance, predator avoidance, temperature preference, and me-

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

tabolism of the fry showed no significant effects attributable to exposure to PCB's and DDE, except for a lowering of preferred temperature at the 25X exposures. Although several factors have undoubtedly contributed to the lack of recruitment of naturally produced lake trout in Lake Michigan, the levels of PCB's and DDE present during the early to mid 1970's were sufficient to significantly reduce survival of any fry produced in the lake and thereby impede restoration of self-sustaining lake trout populations. The added exposure of the fry to other toxic substances known to be present in the lake could have further reduced survival. (Moore-SRC)  
W82-01079

**MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS: REFUGEE MANUAL**,  
RPC, Inc., Austin, TX.  
For primary bibliographic entry see Field 5G  
W82-01081

**HEALTH EFFECTS OF MONOCHLORAMINES IN DRINKING WATER**,  
Massachusetts Univ., Amherst. Div. of Public Health.  
G. S. Moore, E. J. Calabrese, and M. McGee.  
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 239-258, 1980. 3 Tab, 36 Ref.

Descriptors: \*Chlorination, \*Drinking water, Potable water, Disinfection, Chloramines, Water treatment, Water quality, \*Monochloramines.

The possibility that monochloramines in drinking water might alter any of a variety of blood characteristics, including those reflecting oxidant stress, in laboratory mice exposed over a wide range of monochloramine concentrations was investigated. Male A/J mice were randomly allocated to one of seven treatment groups: 200, 100, 50, 25, and 2.5 ppm monochloramine in drinking water plus one group receiving deionized water and one group receiving deionized water with a carbonate-bicarbonate buffer. Exposure continued for 30 days. Significant decreases in water consumption were seen at monochloramine concentrations in excess of 2.5 ppm. No significant treatment-related changes in mortality were seen. With the exception of hematocrit, which rose slightly (possibly due to reduced water intake), none of the blood characteristics indicative of oxidant stress and prehemolytic conditions was significantly affected at any dose level. (Baker-FRC)  
W82-01091

**ASBESTOS CEMENT PIPE AND CANCER IN CONNECTICUT 1955-1974**,  
Yale Univ., New Haven, CT.  
J. W. Meigs, S. D. Walter, J. F. Heston, J. R. Millette, and G. F. Craun.  
Journal of Environmental Health, Vol 42, No 4, p 187-191, January/February, 1980. 1 Tab, 18 Ref.

Descriptors: \*Pipes, \*Asbestos cement, Conveyance structures, Water transport, Public health, \*Carcinogens, Epidemiology.

To assess the possible influences of asbestos cement (A/C) pipe use on cancer occurrence in Connecticut, individual town cancer rates were entered into a regression equation as the dependent variable, while asbestos exposure indicators for each town were entered as independent variables. Over 40 years of cancer incidence data were available. For 82 towns in which public water supplies were delivered either partly or wholly through A/C pipe, chrysotile asbestos fibers per liter were measured at the source and in water that had passed through A/C pipe. None of these towns had asbestos values as high as 100,000 fibers/liter in source waters. No consistent patterns of association between A/C pipe and cancer were found. Fairly consistent associations of certain cancer rates with town population density and socioeconomic status were found. Socioeconomic scores of Connecticut towns were negatively associated with stomach cancer but positively associated with male colon cancer. A positive association between length of

A/C pipe and incidence of kidney cancer was found for both sexes in the 1955-64 study. Also in the 1955-1964 period, a lack of corrosion control for A/C pipes was correlated with bladder cancer, and a high aggressiveness index of water was correlated with colon cancer. No evidence was seen which would warrant changing current water distribution policies for Connecticut public water due to the use of A/C pipes. (Baker-FRC)  
W82-01094

### 5D. Waste Treatment Processes

**FEEDING ANIMALS ACTIVATED SLUDGE**,  
S. Beszedits.  
Water and Pollution Control, Vol 119, No 4, p 16, 17, 27, April, 1981.

Descriptors: \*Domestic animals, \*Feeds, \*Activated sludge, Amino acids, Proteins, Vitamins, Sludge disposal, Industrial wastes, Recycling, Waste recovery.

Properly prepared activated sludge has been fed to chickens, pigs, cattle and other animals in experimental studies for years. It has a 25-40% protein content and is a rich source of B-vitamins. Municipal sewage sludge has been fed to pigs at levels up to 4% and to chickens at 2.5% with no adverse effects. Sludges from industry vary in protein and vitamin content according to their source. Studies on composition and feeding studies of treated wastes from breweries, slaughterhouses, citrus fruit processing plants, canneries, dairies, and cane molasses distilleries are briefly discussed. (Cassar-FRC)  
W82-00523

**FOAM CONTROL IN AERATION TANKS**,  
Terminal Island Treatment Plant, Los Angeles, CA.  
K. L. Ludwig.  
Water/Engineering and Management, Vol 128, No 6, p 34, 39, June, 1981.

Descriptors: \*Water treatment facilities, \*Foaming, \*Foam separation, Wastewater treatment, Secondary wastewater treatment, Industrial wastes, Los Angeles.

The Terminal Island Treatment Plant (TITP) is one of the three large wastewater treatment plants operated by the city of Los Angeles and is located in the Los Angeles Harbor area. TITP is designed to provide complete secondary treatment for an average 30 mgd flow of combined domestic and industrial type wastewaters. The plant relies on the sludge process to achieve the desired level of secondary treatment. The plant operates under diurnal conditions. The present flow through this plant is about 60% of the design capacity, with about 45% of the flow being of industrial origin. Problems encountered due to excessive foam accumulation have been numerous. Foam has overflowed aeration tanks and drained into adjacent pipe galleries. This has required extensive cleanup operations. Since the air feed had to be cut due to extensive foaming, expensive chemical oxygen supplements had to be used. Heavy use of the spray system results in misting conditions arising around the aeration tanks, which leads to numerous other problems as well. TITP tested the Koch Foam Splitter under heavy foam conditions for about six weeks. The unit successfully reduced foams, they were destroyed at the rate of two inches of foam depth per hour for an aeration tank 30 feet wide and 300 feet long. Following the testing period, the foam splitter was installed permanently. While the foam was not completely eliminated, it was controlled. (Baker-FRC)  
W82-00525

**BETTER DEWATERING IMPROVES SLUDGE RECYCLING AND GIVES SIGNIFICANT ENERGY SAVINGS**,  
Racine Wastewater Utility, WI.  
For primary bibliographic entry see Field 5E.  
W82-00526

**PRESSURE SEWER SYSTEMS**,  
Los Angeles County Sanitation District, CA.  
D. Glasgow.  
Water/Engineering and Management, Vol 128, No 6, p 68-70, June, 1981. 2 Fig, 5 Ref.

Descriptors: \*Sewer systems, \*Wastewater collection, Wastewater treatment, Water conveyance, Design considerations, Pressure head, Hydraulics, Equipment, Pumps, Interceptor sewers, Septic tanks, Septic sludge.

In geographical areas where adverse topographical conditions exist, pressure sewer systems have found increasing application. In 1978 a survey revealed that 60 individual pressure sewer systems were in use. Two major types of pressure sewer systems are the grinder pump system and the septic tank effluent pump system. A third type is the variable gradient system. The grinder pump system consists of a holding tank receiving the sewage directly from the service location and retaining it until enough liquid has accumulated to allow the grinder pump to operate for a 1 or 2 minute cycle. The septic tank effluent system consists of a conventional interceptor or septic tank in which the solid materials discharged from the service user are retained in the tank as either settled sludge or as a floating scum. A pressure sewer is normally designed to flow full at all times. During no-flow periods problems can develop due to grease or solids accumulation. Typically the pressure sewer mains are patterned in either dendriform or grid horizontal layouts. Dendriform layouts theoretically require the least amount of pressure sewer main construction. (Baker-FRC)  
W82-00528

**EMPIRE CONTROLLED BY COMPUTER**,  
Short-Elliott-Hendrickson, Inc., St. Paul, MN.  
D. E. Lund.  
Water/Engineering and Management, Vol 128, No 6, p 30-33, June, 1981.

Descriptors: \*Water treatment facilities, \*Computers, \*Wastewater treatment, Tertiary wastewater treatment, Filtration, Sludge, Activated sludge, Effluents, Consolidated facilities, \*Minnesots, Empire, Apple Valley, Lakeville, Farmington.

A two-stage activated sludge process followed by tertiary filtration was suggested for the Empire Wastewater Treatment Plant, serving the communities of Apple Valley, Lakeville and Farmington, Minnesota. A central computer system monitors and controls each process and about 98% of the mechanical equipment throughout the treatment facility. The system consists of two identical computers powered by an uninterruptible power supply. Either computer can serve as the primary unit, with the second one continually gathering data and being maintained in a ready status in case of a malfunction by the other. The computer system also provides the plant operators with numerous reports, logs and displays which alert operators of any critical conditions that may develop in the plant. It also creates many operating reports that normally would require a considerable amount of operator time to complete. Tertiary filtration at Empire is obtained with gravity-type dual-media filters for removal of fine suspended materials. The tertiary filters also provide a substantial safeguard in the treatment process. Methane gas produced during the primary sludge and waste activated sludge thickening process is used as fuel in the plant boilers. (Baker-FRC)  
W82-00529

**MIDWESTERN WASTEWATER CHARACTERISTICS**,  
Environmental Protection Agency, Chicago, IL.  
D. H. Stoltzenberg.  
Public Works, Vol 111, No 1, p 52-53, January, 1980. 3 Fig, 2 Tab, 6 Ref.

Descriptors: \*Wastewater composition, \*Municipal wastewater, Wastewater treatment, Biological oxygen demand, Suspended solids, Water treatment facilities, Illinois, Indiana, Ohio, Minnesota, Surveys, Operating policies.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

Analyses were conducted of data obtained from operation and maintenance inspection forms completed by personnel from the Environmental Protection Agency or state personnel. Inspections were conducted in 1974-1979; reports were analyzed from 100 municipalities in Illinois, Indiana, Ohio, and Minnesota, with treatment plants serving from 10,000 to more than 100,000 inhabitants. Daily per capita loadings for flow, BOD, and suspended solids were about 40% higher than values reported in standard engineering texts. Statistical analysis produced the following values (mean of 100 plants): flow, 166 gallons per capita per day; BOD<sub>5</sub>, 0.203 lb per capita per day; and suspended solids, 0.246 lb per capita per day. Comparable data from the literature were: flow, 58-135 gallons per capita per day; BOD<sub>5</sub>, 0.1-0.2 lb per capita per day; and suspended solids, 0.08-0.23 lb per capita per day. Increased use of garbage grinders may account for the increase in suspended solids loadings. (Cassar-FRC)

W82-00534

**A NOTE ON THE FATE OF EL TOR CHOLERA AND OTHER VIBRIOS IN PERCOLATING FILTERS,**  
Surrey Univ., Guilford (England). Dept. of Microbiology.  
R. R. Daniel, and B. J. Lloyd.  
*Journal of Applied Bacteriology*, Vol 48, No 2, p 207-210, April, 1980. 1 Fig, 1 Tab, 4 Ref.

Descriptors: \*Human disease, \*Percolating filters, \*Anaerobic conditions, \*Vibrio, Performance evaluation, Wastewater treatment, Public health.

Field results and laboratory experiment results are presented from a study designed to test the ability of *Vibrio cholerae* El Tor and non-cholera vibrios to grow in anaerobic sewage effluent. Samples of sewage effluent from the anaerobic settling tanks of the Oxfam Sanitary System contained reduced populations of Enterobacteriaceae and small numbers of non-cholera vibrios (NCV's). Samples were passed through percolating filters made of broken honeycomb bricks or zig-zag stakes of corrugated iron. The NCV's multiplied in both filter types. In the laboratory, NCV's were able to multiply in sewage effluent in static culture. Also, *Vibrio cholerae* El Tor did not multiply in the laboratory but died rapidly. The efficiency of percolating filters may be improved by ensuring an excessively strong liquor and ponding of the liquid. (Small-FRC)

W82-00566

**ENUMERATION OF BACTERIOPHAGES AND HOST BACTERIA IN SEWAGE AND THE ACTIVATED-SLUDGE TREATMENT PROCESS,**  
Clemson Univ., SC. Dept. of Microbiology.  
For primary bibliographic entry see Field 5A.  
W82-00584

**MOVEMENT OF ENDOTOXIN THROUGH SOIL COLUMNS,**  
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.  
For primary bibliographic entry see Field 5B.  
W82-00586

**LAND TREATMENT OF MUNICIPAL WASTEWATER IN SMALL COMMUNITIES,**  
Economics, Statistics, and Cooperatives Service, Washington, DC. Natural Resources Economics Div.

C. E. Young, and D. J. Epp.  
*American Journal of Agricultural Economics*, Vol 62, No 2, p 238-243, May, 1980. 3 Tab, 11 Ref.

Descriptors: \*Land disposal, \*Municipal wastewater, \*Wastewater treatment, Economic aspects, Effluents, Irrigation, Overland flow, Infiltration, Agriculture, Simulation analysis, Crop production, Cost analysis.

Many small communities allocate a substantial portion of their budgets to wastewater treatment. Increasing numbers of small rural communities are being required to provide advanced wastewater

treatment in order to meet surface water quality standards. Land treatment of municipal wastewater can meet water quality standards at about half the cost of other advanced treatment alternatives. Irrigation, overland flow, or rapid infiltration can be used to apply wastewater to land for treatment and removal of pollutants. The cost of land application of wastewater (CLAW) simulation model was used to study the design of land application systems. This computer simulation model can be used to design land application systems capable of treating between 0.1 and 100 million gallons of wastewater per day using solid-set irrigation, center pivot irrigation, border strip irrigation, ridge and furrow irrigation, overland flow, and infiltration basins. The model considers preapplication treatment, effluent transmission, wastewater storage, application method, cropping, and recovery of renovated wastewater, if desired. Capital and operating costs are computed and net crop revenue is determined. The choice of crop is a significant factor in the cost of land application facilities, since crops capable of treating smaller amounts of wastewater or irrigation over shorter periods will necessitate facilities for the storage of wastewater. Federal grants for the construction of wastewater treatment facilities can lead to the choice of an option which minimizes local costs without maximizing the amount of wastewater applied. (Carroll-FRC)

W82-00588

### SYSTEM FOR OIL AND WATER SEPARATION,

J. Di Perna.  
U.S. Patent No 4,203,842, 5 p, 4 Fig, 6 Ref. Official Gazette of the United States Patent Office, Vol 994, No 3, p 987, May 20, 1980.

Descriptors: \*Patents, \*Oil pollution, \*Water pollution treatment, \*Separation techniques, Water quality control, Equipment, Oil tankers.

The principal object of the invention is to provide an improved system for oil and water separation when these fluids are intended to be removed from a ship, so that only the water can be dumped back into the sea while the oil is collected in tanks so as not to pollute the sea water. It provides a system for oil and water separation that utilizes a siphon and vacuum means for moving the oil and water mixture instead of employing a pump. The system includes a relatively small, sealed tank upon the deck of the vessel, a hand controlled vent valve on top of the tank, an outlet end of a siphon line entering the tank while an inlet end of the siphon line may run into a collection or other tank, and discharge lines from lower and upper ends of the sealed tank being connected to pumps for discharging oil at the top and water at the bottom. (Sinha-OEIS)

W82-00611

### CORRELATION OF MICROBIAL DEGRADATION RATES WITH CHEMICAL STRUCTURE,

Environmental Research Lab., Athens, GA.  
For primary bibliographic entry see Field 2K.  
W82-00621

### MANAGEMENT TRAINING IS THE KEY TO GOOD OPERATOR PERFORMANCE,

V. W. Langworthy.  
*Water and Sewage Works*, Vol 127, No 4, p 58, April, 1980.

Descriptors: \*Management planning, \*Training, Administration, Water treatment facilities, \*Wastewater facilities, Water distribution.

The Association of Boards of Certification has worked hard to develop compatibility between states for effective intrastate programming of operator performance levels that are acceptable for water and wastewater operations. Standardization of examination questions and formats among the various grades of certification is one area of concern. A program is needed which will encourage the top individuals in this field to aim for increased self-improvement so that situations which arise can be met by persons capable of handling them. Management/supervisory training is currently available

but few are interested in participating in these programs. Some states are now insisting that an applicant for a managerial position in the water and wastewater industry must have some management expertise. Adequate programs with adequate incentives must be accepted nationwide to increase interest in and appreciation of this area of employment. (Baker-FRC)

W82-00623

### MIXING TECHNOLOGY REDUCES ENERGY USE,

General Motors Corp., Saginaw. Steering Gear Div.

H. G. Peters, Sr.

*Industrial Wastes*, Vol 26, No 3, p 26-27, 34, May/June, 1980.

Descriptors: \*Industrial wastes, \*Energy conservation, \*Water treatment facilities, Wastewater treatment, Design criteria, \*Oil industry, Oil pollution, Oily water, Oil.

Plant needs called for a wastewater treatment facility that could extract both soluble and insoluble oils and reduce phosphate and metal contaminants to proposed acceptable levels, while requiring the lowest levels of energy consumption possible. API-type separators were installed to remove floating oils and extract settleable solids. However, these did not deal with the soluble oils present, which ranged from 1,000-1,500 ppm, with surges as high as 5,000 ppm. A new facility was needed to handle an immediate treatment load of 1.5 mgd, with a longer-term daily treatment potential of 2.5 mgd and a short term emergency capacity of 5 mgd. The facility must extract soluble as well as insoluble oils, thus eliminating the major disposal problem, and reduce phosphate and metal contaminants to acceptable levels. The final design calls for two API-type oil separators, each of 1,000 Gpm capacity, to mechanically remove floating oils and settleable solids. The secondary treatment consists of a batching operation followed by a pumping system and a flow-splitter feeding dual dissolved air flotation cells (DAF). The tertiary treatment stage consists of two parallel systems, each fed by the two secondary DAF's. All stages of the system are supplied with additives. Wastewater passing through a final DAF is monitored for turbidity. An automatic interlock/reject system prevents the release of any wastewater that does not meet discharge standards. Actual oil in the discharge has ranged from 5 to 20 ppm, versus the 100 ppm code standard. (Baker-FRC)

W82-00634

### COLD WEATHER WASTE TREATMENT,

Hoover-NSK Bearing Plant, Ann Arbor, MI.

M. Bitondo.  
*Industrial Wastes*, Vol 26, No 1, p 29, 33, January/February, 1980. 1 Tab.

Descriptors: \*Wastewater treatment, \*Water treatment facilities, Temperature effects, Cultures, Seasonal variations, Bacterial physiology, Cold regions, Winter, Freezing, \*Economic efficiency. \*Ann Arbor, Michigan.

Bacterial supplementation was attempted in wastewater treatment facilities in Ann Arbor, Michigan, where the freezing temperatures encountered during the winter season would kill off the bacteria naturally found in sewage, thereby upsetting the bacterial balance needed for efficient wastewater degradation. During the 1978-1979 winter season, the plant's BOD levels were within state limits in spite of prolonged periods of freezing temperatures. During this time DBC Plus bacterial cultures were used in the bioaugmentation program. In this program specially selected and formulated bacteria are added to a sewage treatment plant. Initially relatively large doses of the preparation are added to fully inoculate the system. Application of the bacterial cultures is easy. The operation costs less than \$100 per month and has enabled the company to meet state standards without expensive new equipment. (Baker-FRC)

W82-00636

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

**FOAM CONTROL AND DEGRADATION OF NONIONIC DETERGENTS,**  
Sybron Corp., Salem, VA. Biochemical Div.  
P. Spraker, and M. Telephak.  
*Industrial Wastes*, Vol 26, No 1, p 16-17, 34, January/February, 1980. 1 Fig, 2 Tab, 1 Ref.

**Descriptors:** \*Industrial wastes, \*Wastewater treatment, Detergents, Soaps, \*Surfactants, \*Phenols, Biodegradation, Foaming, Bacteria, Cultures, \*Textile mill wastes.

A decision was made to treat textile manufacturing wastewater containing phenols and surfactants with biological methods through the addition of mutant bacterial cultures to a biotower and aerated lagoons. The increased efficiencies of the bacteria produced a system capable of biological oxidation with considerably less aeration, with large reductions obtained in energy consumption and cost. Large quantities of foam were not produced by this system. A full scale biotower was designed to remove 150 mg/liter of phenol from 30,000 Gpd wastewater. The biotower structure contains 1,000 cubic feet of packing and has 6,000 gal reservoir capacity. The recycle rate was 960 Gpm. The biotower began showing reduction of the wastewater after 8 days of operation. COD and phenol content were measured. Average COD reductions were between 58-68% from an initial value of 4,481 mg/liter. Phenol content was reduced 99.4% from an original value of 9.2 to 12.8 mg/liter. Data collected over a year's time showed up to 66% reduction of BOD. Thus the system of mutant bacteria and the biotower has produced a much more efficient system, capable of handling difficult to degrade compounds in a more cost effective manner. (Baker-FRC)  
W82-00637

**CHEMICAL TREATMENT SOLVES TANNERY WASTE PROBLEMS,**  
Gunnison Bros. Girard, PA.  
M. Giles.  
*Industrial Wastes*, Vol 26, No 2, p 30-31, March/April, 1980. 1 Fig.

**Descriptors:** \*Tannery wastes, \*Wastewater treatment, Industrial wastes, Water treatment facilities, Biological oxygen demand, Suspended solids, Aerated lagoons, Chemical treatment, Alum, Coagulation.

With the help of chemicals and specialized flexible waste treatment equipment, about 33,000 Gpd of non-uniform wastewater is treated at the Gunnison Brothers tannery in Pennsylvania. The wastewater typically contain lime, hair and other protein, grease and fatty acids, and numerous acids and dyes. A batch type system is used in the wastewater treatment facility. Jar tests are performed daily to determine how the influent will be treated. Use of alum as the primary coagulant in conjunction with other coagulant aids has enabled the tannery to meet regulatory requirements. The company reduced suspended solids from an average of 10,000 mg/liter to 80 mg/liter; oil and grease is reduced from 30 to 10 mg/liter. BOD in the influent is about 2,000, and is reduced to 200 mg/liter. COD is reduced from 15,000 to 1,000 mg/liter. Ammonia is reduced from 100 to less than 50 mg/liter. The primary effluent is pumped to a 450,000 gal aerated lagoon, where detention time is 6-10 days. From the aerobic lagoon the wastewater is pumped to a 55,000 gal secondary settling tank for final liquid/solids separation. Wastewater in the lagoon has picked up biological sludge which is treated in the secondary treatment tank. After flocculating, settling and clarifying the wastewater is disinfected and discharged. The clear effluent flows into Brandy Run, a tributary of Elk Creek which feeds Lake Erie. Dried sludge is hauled off to a sanitary landfill. (Baker-FRC)  
W82-00638

**REMOVAL OF PRIORITY POLLUTANTS,**  
Du Pont de Nemours (E. I.) and Co., Deepwater, NJ.  
D. G. Hutton.  
*Industrial Wastes*, Vol 26, No 2, p 22, 24, 26, March/April, 1980. 6 Tab.

**Descriptors:** \*Industrial wastes, \*Chemical wastes, \*Wastewater treatment, Water treatment facilities, Wastewater, \*Organic compounds, Heavy metals, Acid water, Sludge, Activated sludge.

Du Pont's Chambers Works in Deepwater, New Jersey, has an effective method of handling pollutants from an organic chemicals manufacturing site by neutralization and settling followed by a combined powdered carbon-biological process. The wastewater ranged from 23-50 million gallons per day. Lime slurry is added for neutralization; polyelectrolyte is added to aid in coagulating the flocs prior to primary clarification. Primary sludge settles and thickens in clarifiers, is pumped to storage tanks and filtered to 45% solids concentration, and is disposed of in a lined landfill. Powdered activated carbon is added to the primary clarifier effluent as it is fed to the secondary/tertiary biological aeration tanks. The wastewater is strongly acidic, highly colored and of medium strength. Its BOD/DOC ratio suggests a high fraction of non-biodegradable compounds. The water is slightly brackish and has a relatively low suspended solids content. Primary treatment consisting of lime neutralization and settling was far more important for metals removal than the PACT process. There are at least 20 organic priority pollutants in the plant's wastewater. Thirteen of these are in the volatiles category. The secondary/tertiary PACT process does an effective job of removing organic pollutants, with 90% removal achieved for 13 of them and greater than 75% for 18 of the 20. (Baker-FRC)  
W82-00639

**MECHANISM OF CHARGED MEMBRANE ULTRAFILTRATION OF SALT SOLUTIONS,**  
State Univ. of New York at Buffalo. Dept. of Microbiology.  
C. J. Van Oss.  
*Separation Science and Technology*, Vol 15, No 2, p 159-161, 1980. 7 Ref.

**Descriptors:** \*Acid mine water, \*Filtration, Mine drainage, Acid streams, Acidic water, Membranes, Mine wastes, Industrial wastes, Membrane processes, \*Membrane filters, \*Wastewater treatment, \*Ultrfiltration.

Optimal electrolyte removal by charged membrane ultrafiltration from acid mine water is discussed. A positively charged membrane would be the most effective, given the preponderance of bi- and trivalent cations, in which case the anions used would preferably be monovalent, and since low pH would be desirable to enhance the membrane potential, acidification with hydrochloric rather than sulfuric acid would be preferable. There does not appear to be any advantage in generating greater upstream turbulence than that corresponding to a Reynolds number of about 2500. As high a pressure differential as is compatible with membrane longevity and energy cost should be aimed for, so as to maximize the streaming potential across the pores of the membrane skin and thus the electrolyte retention. Salt retention is likely to be increased by higher temperatures of operation due to the influences of temperature on viscosity, conductivity, and dielectric constant of the solution. If, for reasons of longevity, anionic membranes are preferred, sulfate will lead to a better salt retention than chloride ions, but then a high pH will be more advantageous to attain maximum membrane and streaming potentials. (Baker-FRC)  
W82-00641

**OCCURRENCE OF CYTOPHAGAS IN SEWAGE PLANTS,**  
Gesellschaft fuer Biotechnologische Forschung, m.b.H., Stockheim (Germany, F.R.).  
For primary bibliographic entry see Field 5A.  
W82-00682

**RECEIVING STREAM FISHERIES STUDIES RELATIVE TO SECONDARY TREATED PULP AND PAPER MILL EFFLUENTS,**  
Consolidated Papers, Inc., Wisconsin Rapids, WI.  
For primary bibliographic entry see Field 5C.  
W82-00688

**FUNGAL DECOLORIZATION OF KRAFT BLEACH PLANT EFFLUENTS,**  
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.

D. Eaton, H.-M. Chang, and T. K. Kirk.  
*Tappi*, Vol 63, No 10, p 103-106, October, 1980. 8 Tab, 10 Ref.

**Descriptors:** \*Color removal, \*Pulp and paper industry, \*Fungi, Industrial wastewater, Wastewater treatment, Kraft mills, Effluents, Biological treatment.

Color was reduced by 60% in two to four days in kraft bleach plant effluents using the white rot fungus, *Phanerochaete chrysosporium*. Optimum conditions for decolorization were different from those favoring fungal growth. If the fungus was first allowed to grow at optimum pH, 4.3-4.8, decolorization then proceeded rapidly as low as pH 3. The best temperature for growth was 40 degrees C, but decolorization took place at temperatures as low as 28 degrees C. These results suggest that fungal decolorization is a secondary metabolic event attributable to lignin metabolism. The decolorization continued for 25 days, after which it was necessary to add glucose or cellulose, but not nitrogen. The decolorizing continued for at least 60 days before fresh cellulose was needed. Sodium chloride up to 6000 ppm did not significantly inhibit decolorization. (Cassar-FRC)  
W82-00689

**ANAEROBIC BIOLOGICAL TREATMENT OF FOOD INDUSTRY WASTEWATERS,**  
Water Pollution Research Lab, Stevenage (England).

F. E. Mosey.  
*Water Pollution Control*, Vol 80, No 2, p 273-291, 1981. 9 Fig, 3 Tab, 25 Ref.

**Descriptors:** \*Food processing industry, \*Wastewater treatment, Industrial plants, Anaerobic digestion, Effluents, Food-processing wastes, Industrial wastes, Bacteria.

High-rate biological filtration through plastic media is a rugged, reliable treatment process capable of operating at high organic loadings of two to four kg BOD/cubic meter, which is well in excess of those sustainable in conventional activated-sludge plants or biological filters. The use of anaerobic digestion for the treatment of wastewaters incurred in food processing industries is becoming more and more appealing. Over the past 10 years there has been a worldwide reawakening of interest in this method of digestion, and the process is making great strides on several fronts in the food industry. Hydrogen-utilizing methane bacteria can now be isolated and grown on a large scale in pure cultures. The biochemical pathways of these bacteria are now being studied, with new information being gained into the microbial ecology of the anaerobic digestion process. The translation of these fundamental studies into kinetic data for the process engineer is spawning a new type of anaerobic biological treatment plan every five years. The anaerobic-digestion process is currently the main research topic in the field of wastewater treatment, and its potential for treating warm, moderately concentrated waste waters, especially those produced by the food industry, is both large and increasing rapidly. (Baker-FRC)  
W82-00698

**THE CONTROL OF BACTERIAL POLLUTION CAUSED BY SEA DISCHARGES OF SEWAGE,**  
Wessex Water Authority (England).

R. G. Toms, C. L. Saunders, and E. Hodges.  
*Water Pollution Control*, Vol 80, No 2, p 204-220, 1981. 9 Fig, 1 Tab, 4 Ref.

**Descriptors:** \*Pollution control, \*Wastewater disposal, Outfall, Chlorination, Disinfection, Bacteria, Outfall sewers, Sewers, Seawater, Wastewater treatment, Coastal waters, Water pollution control, \*United Kingdom, Wessex, Model studies.

An EEC directive has imposed bacterial levels on bathing water that are considerably more stringent than frequently is true in inland rivers, particularly

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

downstream from sewage treatment works. The EEC directive has been aimed primarily at protecting the environment and public health. Two methods used in the Wessex Water Authority area to control the bacterial level of bathing waters are described. The siting of a long sea outfall, now being studied at various positions off the Dorset and Somerset coasts, is one method. Use of chlorination to disinfect one important short sea outfall from the Avon coast is the second method. Model studies are being devised to gain more information on the long sea outfall. The studies will consider the effect of winds, including wind-generated shear, and also the effect of the sea bed in reflecting the sewage plume. Chlorination studies have shown this to be an inexpensive method of reducing bacterial populations of bathing water in this area. The total capital cost of equipment was less than 0.5% of the cost of construction of a long sea outfall. Chlorination should, however, be looked on as a short term solution only. (Baker-FRC) W82-00699

#### APPLICATION OF IMMOBILIZED HYDROGENASE FOR THE DETRITIATION OF WATER,

Massachusetts Inst. of Tech., Cambridge. Lab. of Applied Biochemistry.

A. M. Klibanov, and J. Huber.

Biotechnology and Bioengineering, Vol 23, No 7, p 1537-1551, July, 1981. 8 Fig, 35 Ref.

Descriptors: \*Catalysts, \*Tritium, \*Radioactive wastes, Nuclear powerplants, Waste treatment, Bacteria, Enzymes, Hydrogenase, Alcaligenes eutrophus, \*Platinum, \*Wastewater treatment, Isotope fractionation.

Removal of tritium from water contaminated during nuclear power production was accomplished by a catalyzed hydrogen isotope exchange process using immobilized hydrogenase in place of the commonly-used platinum catalysts. Whole bacterial cells of *Alcaligenes eutrophus* immobilized in calcium alginate or K-carrageenan gels were efficient catalysts for the reaction of hydrogen-tritium ( $H-T$ ) exchange in both a batch tank reactor and a column. This enzymatic exchange (an equilibrium between  $HT + H_2O \rightleftharpoons H_2 + HTO$ ) was not controlled by diffusion, as shown by the dependence of the reaction rate on the amount of immobilized cells in the system and the concentration of cells in the matrix. These immobilized cells were active over a wide pH range with a maximum at 6.0-8.0 and were quite resistant to hydrogenase inhibitors such as oxygen and carbon monoxide. The rate of the exchange reaction increased five fold upon increasing the temperature from 4 to 37 C. Ten grams of cells (wet weight) were equivalent in catalyst efficiency to 1 gram of Pt02. The bacterial hydrogenases are inexpensive, readily available, and very active in water. (Cassar-FRC) W82-00768

#### MANGANESE DIOXIDE AS AN ADSORBANT FOR HEAVY METALS,

West Kent Water Co. (England).

For primary bibliographic entry see Field 5F.

W82-00775

DOES IMPROVED WASTE TREATMENT HAVE DEMONSTRABLE BIOLOGICAL BENEFITS,  
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.  
For primary bibliographic entry see Field 5C.  
W82-00779

VEGETATIVE FILTER TREATMENT OF LIVESTOCK FEEDLOT RUNOFF,  
Nebraska Univ. Lincoln. Dept. of Agricultural Engineering.  
E. C. Dickey, and D. H. Vanderholm.

Journal of Environmental Quality, Vol 10, No 3, p 279-284, July/September, 1981. 7 Fig, 5 Tab, 16 Ref.

Descriptors: \*Feedlot runoff, \*Land disposal, \*Biofiltration, Runoff, Filtration, Nutrients, Bio-

logical oxygen demand, Water quality, Water pollution control, Animal wastes.

Four vegetative filters installed on feedlots in central and northern Illinois were evaluated over a 2 year period to determine the feasibility of using these systems for the management of feedlot runoff. Both channelized flow and overland flow systems were studied. Partial solids removal was achieved by settling, following which the runoff was applied directly to the experimental plots. Samples of influent, effluent, and surface flow at intermediate points were analyzed. There was no filter discharge from most runoff events. Runoff from larger events was partially discharged. Treatment with the vegetative filters resulted in reductions of nutrients, solids, and oxygen-demanding materials in the runoff of over 80 percent on a concentration basis and over 90 percent on a weight basis. Both the type of flow and the length of flow affected the degree of pollutant removal. Overland flow systems were more effective than channelized flow systems. Channelized flow systems required much greater flow lengths than overland systems for a similar degree of treatment. The discharge concentrations did not meet water quality standards for the receiving streams. The vegetative filters did not significantly reduce bacteria levels in the runoff. The study results indicate that discharge from adequate size vegetative filters occurs only during large runoff events, when stream flows are also high, and that the overall impact of multiple vegetative filter systems appears to be negligible. (Carroll-FRC) W82-00794

#### BEHAVIOR AND TRANSPORT OF MICROBIAL PATHOGENS AND INDICATOR ORGANISMS IN SOILS TREATED WITH ORGANIC WASTES,

Florida Univ., Stanford. Inst. of Food and Agricultural Sciences.

For primary bibliographic entry see Field 5B.

W82-00797

#### LOW-COST WASTEWATER TREATMENT, C. E. Morris.

Food Engineering, Vol. 53, No. 7, p 51-56, July, 1981. 3 Fig.

Descriptors: \*Food-processing wastes, \*Wastewater facilities, \*Construction costs, Food processing industry, Industrial wastes, Costs, Oily water, Separation techniques, Runoff, Cooling water, Wastewater treatment, Vegetable oil refinery.

The nation's largest independent vegetable oil refinery located in Opelousas, Louisiana, designed and built wastewater treatment facilities to meet federal requirements in one year. Simplicity and redundancy were the keys to designing and building a system to handle both current and future flows. The engineering team hired by the company acted as its own design engineer and general contractor, but used some outside consultants. This approach helped keep costs at 2.2 million. The plant was designed to treat 121,000 gal/day and to handle increased effluent load in the future. Costs were also reduced by using simple oil/water separators in the form of gravity-separation decanters built of fiberglass reinforced plastic. Redundancy in the system permits components to be shut down for cleaning or repair without disrupting the system operation. All pumps were installed in pairs so system operation will not be jeopardized by pump failure. The system treats three wastewater streams: process wastewater, rainwater runoff, and cooling water. Chemical, mechanical, and biological processes are used. Oil residues collected by the stream are approved for soil enrichment. (Small-FRC) W82-00841

#### PURIFICATION OF WASTEWATER BY ELECTROLYSIS,

Chile Univ., Santiago. Dept. of Fisica.

S. Contreras, M. Pieber, and J. Toha.

Biotechnology and Bioengineering, Vol 23, No 8, p 1881-1887, August, 1981. 9 Fig, 1 Tab.

Descriptors: \*Electrolysis, \*Bacteria, \*Disinfection, Flocculation, \*Wastewater treatment, Microbiological studies, Hydrogen ion concentration.

A simple and rapid wastewater treatment procedure is presented which is based on an electrolytic treatment. Wastewater samples containing an equivalent of 1 g of total solids per liter and about 10 to the 6th power microorganisms per liter were processed. Electrolysis was carried out at 30 V and 200 mA in a cell with two electrodes separated by an asbestos plate. Flocculation of the suspended material present in the wastewater was followed by optical density measurements. The number of microorganisms was evaluated before and after treatment. The percentage of microorganism survival decreased exponentially with increasing electrolysis time. The percentage of microorganisms decreased exponentially with increasing water volume. The effect of pH on microorganism viability was also investigated, and above and below neutral pH the percentage of microorganism survival decreased exponentially. Thus, the method can be used to produce clarified water free of microorganisms. (Small-FRC) W82-00847

#### SEDIMENTATION OF ZEOLITE TYPE A IN WATER AND WASTE WATER,

Imperial Coll. of Science and Technology, London (England).

M. J. T. Carrondo, R. Perry, and J. N. Lester.

Canadian Journal of Civil Engineering, Vol. 8, No 2, p 206-217, June, 1981. 9 fig, 6 Tab, 35 Ref.

Descriptors: \*Sedimentation, \*Zeolites, \*Wastewater treatment, Sedimentation rates, Activated sludge, Detergents, Suspended solids.

Zeolite type A is a synthetic aluminosilicate which has been considered as a possible substitute for phosphorus builders in detergents. A series of experiments was conducted to investigate the settling characteristics of zeolite type A in water and waste water. Settling column tests yielded results which compared well with predictions made by applying Stokes' law to the particle size distribution curves, despite the non-sphericity of the particles. Predictions of removals at different overflow rates made from the column tests were in substantial agreement with the results of the model sedimentation tank tests. Zeolite type A removal in water was low even at low flow rates. The presence of zeolite type A resulted in slight reductions of the percentage of suspended solids removed in static column tests using raw sewage. Zeolite type A was removed to a lesser extent than the other suspended solids, particularly during the initial stages of settling tests. Zeolite type A removal averaged 88 percent in activated sludge pilot plant tests. These results indicate that zeolite type A removals higher than 80 percent can be anticipated in wastewater treatment facilities using primary settling and secondary treatment by activated sludge; removals greater than 90 percent are regarded as probable. (Carroll-FRC) W82-00848

#### PILOT PLANT PERFORMANCES IN MUNICIPAL WASTEWATER TREATMENT BY ACTIVATED CARBON ADSORPTION,

Lagos Univ. (Nigeria). Dept. of Civil Engineering.

K. O. Iwugo, and R. J. Martin.

Effluent and Water Treatment Journal, Vol 20, No 7, p 327-329, 332-336, July, 1980. 6 Fig, 2 Tab, 30 Ref.

Descriptors: \*Activated carbon, \*Organic compounds, \*Adsorption, \*Pilot plants, Color removal, \*Wastewater treatment, Organic carbon, Suspended solids.

A 0.5 cu meter per day sand-anthracite filtration-carbon adsorption pilot plant was operated under varying hydraulic loadings, organic loadings, and pH conditions to study removal of organics from municipal wastewater effluents. The carbon bed effluent organic carbon concentration varied almost directly with the concentration in the effluent after a steady state had been reached. This indicates that a certain fraction of organics in the

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

biologically treated sewage effluent cannot be adsorbed in this system no matter how the operating conditions are varied. The removal rates for various parameters (in mg per liter) in the granular carbon bed are summarized as follows: total organic carbon, 46.1%; soluble organic carbon, 49%; suspended solids, 56.8%; BOD<sub>5</sub>, 55.1%; BOD<sub>20</sub>, 24.5%+ and color, 90%. (Cassar-FRC)  
W82-00851

#### CHLORAMINE-T AS A POTENTIAL SCRUBBING AGENT: REMOVAL OF ODOROUS SULFUR-CONTAINING ENVIRONMENTAL POLLUTANTS,

Texas Univ., Galveston. Medical Branch.  
N. M. Trieff, N. M. Made Gowda, and V. M. Sadagopan Ramanujam.

Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 383-388, 1980. 2 Tab, 11 Ref.

Descriptors: \*Sulfur, \*Odor control, Water pollution, Air pollution, \*Industrial wastes, \*Oxidation, Wastewater, Phenols, Carcinogens, Pollutants, Organic compounds, Chemical reactions, Chemical industry, Chemical treatment.

A detailed study of the reaction of thiocacetamide, thiobenzamide, and other industrial pollutants with chloramine-T has been conducted. Odor studies were performed on the reactants and the reaction mixtures. In all cases, reaction with chloramine-T raised the odor threshold concentration. Results suggest that this oxidative technique has potential application in removing odorous contaminants from stock gases and industrial wastewater effluent. (Titus-FRC)  
W82-00871

#### FACTS FIX FUND FINDING,

Havens and Emerson Ltd., Cleveland, OH.  
For primary bibliographic entry see Field 9A.  
W82-00885

#### DAIRY LIQUID WASTE DISTRIBUTION IN AN OVERLAND FLOW VEGETATIVE-SOIL FILTER SYSTEM,

Southern Illinois Univ. at Carbondale. Dept. of Agricultural Industries.

J. J. Paterson, J. H. Jones, F. J. Olsen, and G. C. McCoy.

Transactions of the ASAE, Vol 23, No 4, p 973-977, 984, July/August, 1980. 3 Fig, 3 Tab, 6 Ref.

Descriptors: \*Industrial wastewater, \*Dairy industry, \*Land disposal, Animal wastes, \*Wastewater disposal, Wastewater irrigation, Overland flow, Water pollution control, Vegetation, Soil-water-plant relationships, \*Feedlot wastes.

A vegetative-soil filter system provides a disposal method for livestock wastes which small operators can install themselves and which may be substituted for a zero-discharge system where the dairy herd comprises 100 cows or less. Distribution and management problems resulting from the use of 10 centimeter diameter polyvinyl chloride (PVC) pipe for a 'sheet flow' vegetative-soil filter system for liquid wastes from a 70 cow dairy operation are discussed. The liquid dairy wastes consisted of liquid waste from the feedlot resulting from runoff during rainfall and snowmelt plus liquid waste from the milking parlor and milkroom washwater. The width of effluent discharge was too narrow to make the best use of the utilization area when the pipe distribution line was shorter than 9 meters. Distribution lines longer than 30 meters were difficult to level for uniform flow. Under wet conditions, 1 gallon per square yard per day was found to be a safe loading rate for the filter area, except during rainfall and snowmelt events. During high rainfall events, pollution can be minimized by increasing the flow distance from the settling basin to the disposal area. The botanical composition of the filter area changed significantly over the 2-year period during which wastewater from livestock was applied daily to tall fescue sod. Maintaining a suitable grass cover was a major problem. The advantages of rotating between two or more utilization areas on a weekly basis with respect to

maintenance of a grass cover are being investigated. Analysis of effluent samples from the disposal sites showed that the grass filter effectively removed pollutants from the liquid dairy wastes. (Carroll-FRC)  
W82-00897

#### SEPARATION OF SELENIUM FROM SULFIDE LEACH LIQUORS,

Canmet, Ottawa (Ontario). Mineral Sciences Lab. V. S. Sastri, and K. S. Subramanian.

Separation Science and Technology, Vol 15, No 1, p 75-79, 1980. 2 Tab, 7 Ref.

Descriptors: \*Selenium, \*Leaching, Metals, \*Industrial wastes, Wastewaters, \*Wastewater treatment, Coprecipitation, Cation exchange, Ion exchange.

The removal of selenium from leach liquors and metal-barren effluents before discharging into the natural waterways is essential due to the fact that selenium and its various compounds are extremely toxic and carcinogenic. A systematic study of the separation of selenium from leach solutions is presented. Selenium can be separated as the thiol complex by the procedure of Kovalskii. To effect removal as cuprous selenide, buffer solution composed to citric acid and copper sulfate with a pH of 4.5 and aqueous ammonia was added to neutral Se(IV) solution. Aqueous hydroxylamine sulfate solution (1 ml of 10% solution) was added, and the mixture placed in a small funnel in the neck of a flask. After boiling and subsequently cooling, the contents were filtered through a microfilter stick. Separation as lead selenite is achieved by the procedure of Jachwerth based on coprecipitation of selenite as lead selenite with lead sulfate, which is subsequently dissolved in ammonium tartrate solution and the solution analyzed for selenium by a spectrophotometric method using 3,3'-diaminobenzidine as the organic complexing reagent. The separation of selenium by coprecipitation with arsenic is also possible. To achieve separation by cation exchange, an ion-exchange column 30 cm long and 2 cm in diameter is filled with cation exchange resin. The selenite solution is passed through the column; the effluent is collected and analyzed for selenium by a spectrophotometric method using 3,3'-diaminobenzidine as the complexing agent. Of these methods, the cation exchange chromatographic method gave the best separation. Coprecipitation with arsenic gave poor results. High recoveries were obtained in the case of separation as cuprous selenide. (Baker-FRC)  
W82-00905

#### FLOC/FLOAT SYSTEM CLEANS DESALTER EFFLUENT,

Pielkenrood-Vinitex, Assendelft (Netherlands).

H. Kleen, and H. Marson.

Oil and Gas Journal, Vol 78, No 36, p 76-78, 80, September 8, 1980. 4 Fig, 1 Tab, 3 Ref.

Descriptors: \*Industrial effluents, \*Flocculation, \*Wastewater treatment, Refinery wastes, Water treatment, Chemical coagulation, Dispersants, Emulsions, Industrial wastes, \*Oil industry.

Difficult and expensive problems were caused by emulsions that formed in desalter effluent water from a Dutch refinery. The problematic emulsions formed, both water-in-oil and oil-in-water, had formerly passed through the system unseparated. They were removed with the oil and passed through a complete circuit. They built up in the cycle until on some occasions the separator system became blocked by viscous, jelly-like masses of emulsion. Solution was achieved by a design employing flocculation in a tilted plate flocculator and flotation. Alum was chosen as flocculant. Flootation was achieved by microbubbles generated from pressurized dissolved air. The treated water which flows into the main waste water treatment system is sufficiently purified to fall within the specification of 30 mg oil/kg which the refinery is expected to meet. The improvement of desalter effluent quality has reduced the frequency of plant shutdown due to exceeding the allowed population equivalent limit in the water discharge from four

shutdowns to one shutdown per year. (Baker-FRC)  
W82-00906

#### MASSIVE CULTIVATION OF MICROALGAE: RESULTS AND PROSPECTS,

Kernforschungsanstalt Juelich (Germany, F.R.). Inst. fuer Biotechnologie III.

C. J. Soeder.

Hydrobiologia, Vol 72, No 1/2, p 197-209, July, 1980. 2 Fig, 10 Tab, 72 Ref.

Descriptors: \*Algae, \*Biological wastewater treatment, \*Water reclamation, Wastewater treatment, Feeds, Reviews, Economic aspects, Bacteria, Waste treatment, Spirulina, Chlorella, Scenedesmus, Irrigation water, Manure, Animal wastes, Chemical wastes, Effluents, Lagoons, Algae harvesting, Agriculture, Protein, Tropical regions, Impaired water use.

Mass production of microalgae is reviewed with special emphasis on the most promising technology, treatment of wastewater with algae-bacteria systems to yield a proteinaceous biomass suitable as a food. These processes vary from growing Spirulina on fermented cow dung in a ditch in India to the sophisticated Japanese Chlorella factories. High rate algae ponds, which represent great improvement over sewage or effluent treatment in deep unlined ponds at long retention times, feature intensive mixing and night-time aeration. Results are aerobic wastewater treatment, reclamation of treated water for use in irrigation, and the proteinaceous algae-bacteria biomass suitable for animal feed. Least energy consuming harvesting methods are sedimentation, filtration, and flotation. Among the highest yield values reported are a mean efficiency of photosynthetic active radiation conversion of 4.8% in Bulgaria. Addition of organic substrates boosts the yields. Nutritional and toxicological aspects of algae culture are discussed. The most promising fields for increasing microalgae production are in cases where algae are obtained as byproducts from urban sewage treatment, animal wastes, mineral fertilizer wastewater, soda manufacture from carbonate brine, and ammonia or urea manufacture. (Cassar-FRC)  
W82-00913

#### KINETICS OF NITRATE AND AMMONIUM UPTAKE BY THE TROPICAL FRESHWATER MACROPHYTE PISTIA STRATIOTES L.

Guam Univ., Agana. Marine Lab.

S. G. Nelson, B. D. Smith, and B. R. Best.

Aquaculture, Vol 24, No 1/2, p 11-19, May, 1981. 5 Fig, 1 Tab, 19 Ref.

Descriptors: \*Nitrogen, \*Kinetics, \*Aquaculture, Nutrients, Macrophytes, Ammonium, Nitrates, Tropical regions, Wastewater treatment.

The kinetics of nitrogen uptake were examined for a common freshwater macrophyte Pistia stratiotes L. Nitrate-nitrogen and ammonium-nitrogen uptake were examined over a wide range of substrate concentrations gather information which would be useful in the design of aquaculture systems for ammonium and nitrate removal. Nitrate uptake rates were higher after 24 hr of exposure to the nitrate source than immediately after exposure. The rate of uptake of nitrate-nitrogen was greater in the light than in the dark. Nitrate uptake followed a pattern which could be adequately described by the Michaelis-Menten expression. Ammonium nitrogen uptake response to substrate concentration appeared to be linear. Rates of ammonium-nitrogen uptake was similar in the dark and in the light. For any given dissolved nitrogen concentration, the rate of ammonium-nitrogen uptake was greater than the rate of nitrate-nitrogen uptake. (Baker-FRC)  
W82-00937

#### POTENTIAL FOR LAND DISPOSAL OF TWO NONBIODEGRADABLE WASTES,

Delaware Univ., Newark. Dept. of Agricultural Engineering.

W. F. Ritter, R. P. Eastburn, and M. P. Neisser.

Transactions of the ASAE, Vol 24, p 945-950, July/August, 1981. 8 Fig, 5 Tab, 14 Ref.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

Descriptors: \*Land disposal, \*Industrial wastes, Nylon, Waste disposal, Wastewater disposal, Groundwater, Water pollution sources, Groundwater pollution, \*Nonbiodegradable wastes.

A series of laboratory and greenhouse experiments was conducted to evaluate the potential for land disposal of some nonbiodegradable nylon processing wastes. Two wastewaters from experimental nylon manufacturing processes were subjected to soil column, lysimeter, adsorption, phytotoxicity and biodegradation studies. The major objectives were to determine whether the wastewaters were degraded by soil microorganisms and whether land disposal could be used for the wastewaters. Two wastes of differing chemical composition were used in the study. The chemical oxygen demand concentrations of the leachate for wastes A and B versus the amount of wastewater applied at different loading rates was determined. At a low application rate of 1.3 cm/week, no leachate samples were collected for five weeks due to evaporation. In general, the soil column profiles did not remove any more COD after about 36 to 48 cm of wastewater was applied, indicating that adsorption of the organic material to the soil particles was small. The pH of the leachate varied from 5.0 to 8.0 for wastes A and B. Samples of leachate were collected for 15 weeks from the lysimeters after the initial wastewater application. Neither waste A nor waste B adsorption could be described by the Langmuir equation or the Freundlich equation. Wastewater was applied to the pots in the greenhouse study for 18 weeks. One week after application began, the grass being treated with waste B became chlorotic. High application rates appeared to have an adverse effect on the vegetation. It was concluded that the potential for using land treatment for nonbiodegradable wastes is limited. These types of wastes could cause serious groundwater contamination. (Baker-FRC) W82-00939

#### EXTRACTING HEAVY METALS AND TOXIC ORGANICS FROM SLUDGE,

A. A. Kalinske.

Water/Engineering and Management, Vol REF, No HB, p R148-R151, 1981.

Descriptors: \*Sludge, \*Toxicity, \*Wastewater treatment, Sludge thickening, Sludge drying, \*Sludge disposal, \*Heavy metals, Organic compounds, \*Sludge conditioning.

In order to make a sludge or residue non-hazardous, it may be necessary to reduce its heavy metal content. Municipal wastewater treatment plant sludge from primary and secondary treatments will contain various amounts of toxic organics such as chlorinated hydrocarbons and toxic heavy metals. Most of these are only slightly soluble in water and tend to adhere to the suspended solids in the wastewater. The biological organisms in the secondary plant, especially those in the sludge process, have a considerable capacity to remove heavy metals present in fine particulate form and in soluble form. Metal concentrations in the raw sewage coming to any treatment plant are relatively low. Chemical treatment, such as for phosphorus removal, will usually cause additional heavy metals to be removed from the sewage by precipitation due to increases in acidity and by coagulation of colloids. The ratio of soluble to insoluble concentration of the various heavy metals in liquid sludge can be changed by the addition of chemicals for conditioning, if the pH is changed. An elevated pH will cause precipitation, to some degree, of most of the heavy metals present in solution. There are also systems for heat-treating a liquid sludge so as to condition it in order to obtain excellent dewatering without using any chemicals. The sludge is raised to a temperature of 180–210 degrees C, under pressure conditions, and held for about 30 min. Heat drying of sludge is done at some wastewater treatment plants to prepare a saleable product for use as a soil conditioner with some fertilizing properties. (Baker-FRC) W82-00947

#### CONTROL SYSTEMS FOR RETURN AND WASTE SLUDGE,

Metropolitan Sanitary District of Greater Chicago, IL.

R. L. McCarthy, and R. L. Sokol.

Water/Engineering and Management, Vol REF, No HB, p R152-R154, 1981. 3 Fig, 1 Tab.

Descriptors: \*Sludge, \*Control systems, Equipment, Sludge excess, \*Wastewater treatment, Activated sludge.

Devices, instruments, and piping arrangements which may aid in the application of processes governing the return and wasting of sludge are discussed. Sludge level sensors, air lifts, and a variety of control arrangements in use are described. While air lift with gravity return is still the primary method of returning sludge in the district of Greater Chicago, several new devices have improved the process, one of which is the sludge level sensor. There are two types of sensors; one, a sonic sensor, is based on the fact that an ultrasonic signal will attenuate to a large degree when passing through a liquid containing suspended solids as opposed to passing the signal through clear water. The second, the light sensor, uses a highly sensitive photocell and an infrared or ultraviolet light source in a probe suspended in the tank. The system is presently arranged so that the return sludge rate may be selected and the system kept in balance automatically by variation of the waste sludge rate with changing level of the sludge blanket. All sludge withdrawn from the tank is air lifted into a return sludge channel. The return sludge flow into the aeration tanks is controlled, based on varying sewage flow and a preset return sludge ratio. The amount of lift needed to return final tank sludge back to the aeration tanks is usually less than 3 feet. The back-up system for all controls is the sludge level indicator. The operator on duty makes charts which show four circles and which are penciled in whenever the sludge reaches a certain indicator pipe. If necessary this information when given to the shift operator can be used to make adjustments. (Baker-FRC) W82-00949

#### AN ALTERNATIVE WASTEWATER DISINFECTANT,

Maryland Environmental Service, Annapolis.

D. J. Greene.

Water/Engineering and Management, Vol 128, No 7, p 47-48, July, 1981. 6 Fig.

Descriptors: \*Bromine chloride, \*Disinfectants, \*Secondary wastewater treatment, Wastewater treatment, Chlorination, Fish, Toxicity.

Bromine chloride was cost competitive and offered advantages over other disinfectants in field trials at an activated sludge secondary wastewater treatment plant in Sykesville, Maryland. The 5 min control point residual required was 0.8 ppm equivalent total chlorine to produce a < 200 fecal coliform per 100 ml effluent level and low or nondetectable residual in the final effluent. In a 96-hour fish survival test with fathead minnows, no fish were killed by 8 ppm BrCl in effluent, while 100% were killed in 8 ppm Cl<sub>2</sub> in effluent. Bromine chloride has several advantages over chlorine. It is liquid at room temperature, 12 times more soluble in water, and more effective at lower temperatures. Bromamines formed in the process are less stable and therefore less harmful to aquatic life. Total treatment costs in cents per 1000 gal based on a 100 mgd plant are 1.6 for chlorobromination (5 ppm) and 1.9 for chlorination/dechlorination/postaeration. (Cassar-FRC) W82-00950

#### SLUDGE BLANKET IN ACTIVATED FINAL CLARIFIERS,

Envirex, Inc., Milwaukee, WI.

W. H. Boyle.

Water/Engineering and Management, Vol REF, No HB, p R124, R129-R130, 1981. 3 Fig, 3 Tab, 5 Ref.

Descriptors: \*Clarifiers, \*Activated sludge, Sludge, \*Wastewater treatment, Clarification, Chemical precipitation, Water treatment.

Activated sludge acts as a liquid and therefore seeks its own level on entering the final clarifier of a wastewater treatment plant. The heavier mixed liquor, on entering the final clarifier basin, drops to the floor or sludge blanket. It then travels along the floor until it hits an obstruction such as the peripheral wall for the center feed clarifier. Activated sludge does not settle as a discrete particle, but rather in a hindered zone of influence, and not therefore governed solely by Stokes' law of settling. Activated sludge has no choice but to seek its own liquid mass level in a clarifier if no mechanical or hydraulic limitations are imposed on it. The sludge will not likely be a homogeneous solid mixture in the sludge blanket, nor will the sludge blanket have a constant concentration of solids per unit area of the tank floor. Since sludge in each plant is different, the relative concentration will vary, but the random pattern of the contour lines of sludge will probably not differ significantly. A theoretical removal point will pass through as many as eight different solids contours for half the basin. It would be most difficult to design a sludge collector for rapid adjustment to each different concentration point. Even if well defined radial concentration points did exist, it would be impossible to say where the heavy versus the light sludge would be at any given time. To satisfy most mass loading theories and practical applications of final clarifiers, the designer and operator must take into account that sludge will settle at a level elevation and should be removed to sustain this level. While the solids concentration in the sludge blanket is not perfectly uniform, the removal device should be designed as though it were. (Baker-FRC) W82-00951

#### AUTOMATION OF NORWICH SEWAGE-TREATMENT WORKS: EARLY COST CONSIDERATIONS,

Anglian Water Authority, Norwich (England). Norwich Sewage Div.

J. Hemmey, and A. Latten.

Water Pollution Control, Vol 80, No 3, p 341-355, 1981. 2 Fig, 10 Tab, 7 Ref.

Descriptors: \*Automation, \*Cost analysis, \*Wastewater treatment, Water treatment facilities, Maintenance, Operating costs, Maintenance costs, \*Norwich, England.

The effects of automated procedures on operating costs experienced at the Norwich sewage treatment works are described. An actual savings of 25,900 pounds Sterling/year thought to be attributable to automation was realized on operation. The desludging of primary sedimentation tanks was not cost effective on automatic control. However, if the same system were to be designed today, the eight ultrasonic sludge density indicators currently employed could be reduced to two, and this fact alone would mean that the costs would approximately balance the tangible benefits. The performance of the activated sludge plant during the automatic control period was clearly superior to that during the period of manual control. In efforts to gain cost figures regarding dissolved oxygen control, the DO control system of the 27.5 tcmd design DWF six-channel diffused-air, activated-sludge plant used up to four EIL Makereh DO sensors, positioned at various points around the aeration channels. To obtain data for a manual vs. automated operation, the DO control system was shut down for a time period and the DO controlled by manual adjustments to blower speed. Records of labor, power consumption, and plant performance were kept. In both manual and automated periods of operation the plant was operating in a non-nitrifying mode, and air supplied above that required to satisfy base respiration was substantially used in carbonaceous oxidation. Comparing the final costs indicated by the systems showed a present value saving on automatic control of 122,506 pounds, which is about equal to 1.5 operators or about 64 man-hr/week. (Baker-FRC) W82-00955

#### GUIDELINE TABLES TO INDUSTRIAL WASTES PROBLEMS.

Water and Pollution Control, Vol 119, No 6, p 10-12, June, 1981. 1 Tab.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

**Descriptors:** \*Wastewater treatment, \*Industrial wastes, \*Industrial wastewater, Water quality standards.

An extensive table is presented which outlines treatments available for industry's major problem wastes. The table lists the industry, its waste problems, possible treatments, and guidelines and standards for maximum concentrations. Industries considered include basic iron and steel, agricultural chemicals, inorganic chemicals, organic chemicals, food processing, metal working and finishing, petroleum and petrochemicals, mining and metallurgy, pulp and paper, transportation industries, and tanning and rendering. Most of these wastes are in the form of contaminated water, although solid wastes are also mentioned in the table when appropriate. (Small-FRC)  
W82-00956

**THE CAPE FLATS SEWAGE TREATMENT WORKS,**  
J. G. Brand.  
Civil Engineer in South Africa, Vol 23, No 4, 124, April, 1981.

**Descriptors:** \*Wastewater facilities, \*Water reuse, \*Activated sludge process, Wastewater renovation, Potable water, Secondary treatment, Oxidation, Sedimentation, \*South Africa.

The Cape Flats Sewage Works, which treats primarily domestic sewage, handles an inflow of 150 Mlitors/day. The older Athlone Works treats primarily industrial wastes, which are generally too saline to be reclaimed for potable use. At the Cape Flats plant, sewage is screened and grit is removed before passing into primary settling tanks and then into aeration reactors. After secondary settling, the effluent is discharged into oxidation ponds. The sludge is ultimately sold as fertilizer. The project was started in 1977, and the final value of contracts awarded was R22 million. The architectural design of the facility won a commendation by the Concrete Society of Southern Africa. Buildings such as the inlet works and blower house comprise concrete portal frames clad in color-coated curved asbestos sheeting. Selection and design of the basic process were carried out with a view to immediate compliance with the final effluent standards, and to the ultimate objective of water reuse. (Small-FRC)  
W82-00957

**THE FATE OF HEAVY METALS IN THE RUHR SYSTEM AND THEIR INFLUENCE ON DRINKING WATER QUALITY,**  
Ruhrverband, Essen (Germany, F. R.).  
For primary bibliographic entry see Field 5B.  
W82-00962

**FLUIDIZED BED FOR BIOLOGICAL WASTEWATER TREATMENT,**  
Patras Univ. (Greece). Lab. of Applied Thermodynamics.

T. C. Stathis.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 227-241, February, 1980. 1 Fig, 1 Tab, 15 Ref.

**Descriptors:** \*Biological wastewater treatment, \*Fluidized beds, Wastewater treatment, Biological treatment, Fluidized bed process, Microorganisms, \*Nassau County, New York.

A fluidized bed system is described that is used in the treatment of municipal wastewater from Nassau County, New York, at its 60 mgd treatment plant at Bay Park, New York. Using a pilot plant of 72,000 gal/day, the 94 mg/liter of incoming primary soluble BOD effluent was being reduced to 11 mg/liter within a 16 minute total detention time. The recycle ratio for this case was equal to 2.2. Sand was used as the granular medium in the fluidized bed; this acts as a support surface upon which the biological population grows. Wastewater is first pumped through a pressurized oxygen mixing tank, where it is hydraulically mixed with pure oxygen gas and subsequently fed to the fluidized bed reactor. The fluidization of the

media allows solids to pass through, thus overcoming the problems associated with packed bed systems, such as plugging and frequent backwashing. The fluidized bed system offers a much higher surface area per unit volume of reactor on which the microorganisms grow, and therefore it can operate with much higher concentrations of biological mass than other systems. As a result, the fluidized bed system requires considerably less space and lower construction costs than other systems, and it should be considered as a welcome addition to the variety of wastewater treatment systems available. (Baker-FRC)  
W82-00968

**MULTICHAMBER SEPTIC TANKS,**  
Connecticut Univ., Storrs. School of Engineering.  
R. Laak.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 539-546, June, 1980. 3 Fig, 29 Ref.

**Descriptors:** \*Septic tanks, \*Effluents, Design criteria, \*Wastewater treatment, Wastewater Planning, Suspended solids, Biological oxygen demand, Multichamber septic tanks.

The concept of a multichambered septic tank is considered in contrast to the single chamber tank, which is conventionally used for small flows only. Multichamber tanks appear superior to single-chamber tanks in that up to 50% less suspended solids remain in the effluent. A change from a single chamber to a multi-chamber tank can mean a change in suspended solids removal from 75% to 80%. This represents a 20% suspended solids load improvement on the seepage bed. The surface area/depth ratio for each compartment, the loading intensity, and the outlet configuration show a significant effect on effluent quality. While overloaded tanks will undoubtedly fail, multichamber tanks often perform longer at a more satisfactory rate. To be effective, septic tanks should have a detention period longer than 24 hr, an outlet configuration with a gas baffle, maximized surface area/depth ratio for all chambers, and a multichamber tank with interconnections similar to the outlet design. (Baker-FRC)  
W82-00969

**CATION TRANSPORT IN PACKED BED REACTOR OF SOIL,**  
Florida University, Gainesville, Agricultural Engineering Department.

A. R. Overman, B. R. McMahon, R. L. Chu, and F. C. Wang.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 267-277, April, 1980. 16 Fig, 1 Tab, 12 Ref.

**Descriptors:** \*Soil disposal fields, \*Cation exchange, Model studies, Tertiary wastewater treatment, Wastewater treatment, Municipal wastewater, Kinetics, Waste disposal, Wastewater disposal, Land disposal, \*Ion transport.

Cation exchange is an important process in the land treatment of municipal wastewater, since it influences the availability of several nutrients for crop uptake as well as the buffer capacity of the system to shock loading. A model of cation transport through a packed bed of soil is presented. Components of the model include convection, dispersion, and ion exchange. The method of finite differences as proposed by Gupta and Greenkorn is used to obtain a mathematical solution to the nonlinear system. The component for cation exchange is based on second-order kinetics in accord with the law of mass action. For the experiments conducted the packed bed reactor was packed with Lakeland fine sand to a bulk density of 1.66 g soil per cubic meter and a porosity of 0.376. After purging the soil air with carbon dioxide, the reactor was saturated with distilled/deionized water to assure total saturation so that pore velocities could be calculated. Several pore volumes of ammonium chloride were passed through to saturate exchange sites with ammonium ion. The pH was adjusted to 6.5. Samples were analyzed for ammonium ion

with a spectrophotometer, for potassium by flame photometry, and by titration for chloride ion. Experiments were conducted by switching between ammonium chloride and potassium chloride of the same molar concentration and at pH 6.5. The findings indicate that the dynamics of cation exchange in packed soil depend upon water flow and ionic composition of the soil solution. Increases in ionic strength or flow velocity greatly increase the rate of cation exchange. The performance of land treatment systems depends on intricate coupling among hydraulic, chemical, and biological processes. (Baker-FRC)  
W82-00970

**BIOLOGICAL TREATMENT OF SYNTHETIC FUEL WASTEWATER,**  
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.

R. G. Luthy, D. J. Sekel, and J. T. Tallon.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 609-629, June, 1980. 5 Fig, 4 Tab, 20 Ref.

**Descriptors:** \*Biological wastewater treatment, \*Coal gasification, Wastewater treatment, Nitrification, Biological treatment, Ammonia, Nitrogen, Biological oxidation, Oxygen demand, Biological oxygen demand, Industrial effluents, Effluents, Gaseification.

The possibility of using biological methods for the treatment of wastewater heavily laden with organic contaminants arising from a coal gasification pilot plant was investigated. The wastewater used was obtained from the Grand Forks Energy Technology Center gasifier in Grand Forks, ND. The wastewater effluent was double decanted to remove most of the tar and oil prior to shipment. The wastewater contains on the order of 0.4 equivalents per liter total ammonia and 0.4 equivalents per liter of alkalinity. Most of the ammonia present is present as free ammonia. Wastewater was pretreated by dosing with lime to precipitate alkalinity as a calcium carbonate sludge and to raise pH when air stripping ammonia. Ammonia stripping was done to prepare influent to the biological cells. Stripping lowered ammonia concentration from an average level of 5,150 mg/liter to 330 to 580 mg/liter. Lime pretreatment and ammonia stripping removed 84% of raw wastewater alkalinity and 91% of wastewater ammonia, resulting in a significant decrease in wastewater conductivity. COD demand was reduced by 14%. Sulfide was reduced to 5 mg/liter. Biological reactors were seeded with activated sludge. Treatment of ammonia stripped wastewater at 25% strength showed very stable operating conditions. Effluent volatile suspended solids and phenolics were low, there was high removal efficiency for thiocyanate and chemical oxygen demand, and nearly complete nitrification of influent ammonia was achieved. Final studies showed wastewater could be processed at 40% strength and that nitrification was feasible with both stripped and unstripped wastewater. (Baker-FRC)  
W82-00971

**VACUUM FILTRATION OF METAL HYDROXIDE SLUDGES,**  
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.

W. R. Knocke, M. M. Ghosh, and J. T. Novak.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 363-376, April, 1980. 9 Fig, 1 Tab, 14 Ref.

**Descriptors:** \*Sludge, \*Vacuum filtration, Sludge dewatering, Filtration, Metals, \*Wastewater treatment, Industrial wastes, Separation techniques.

The characteristic response of metal hydroxide sludges to vacuum filtration was examined. Both individual and mixed-metal sludges were examined regarding sludge dewatering rates, handling properties, and filtrate quality obtained during vacuum dewatering. Sludge parameters such as mean particle size and size distribution, as well as operational

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

parameters such as precipitation pH, were evaluated to better define their effect on the dewatering of metal hydroxide sludges. It was concluded that most metal hydroxide sludges will yield acceptable dewatering rates when subjected to vacuum filtration. Sludges of high specific resistance can be conditioned through the addition of high molecular weight polyelectrolytes. The penetration of solids during vacuum dewatering must be dealt with for certain metal hydroxide sludges. Small additions of polyelectrolyte were helpful in minimizing the amount of solids in the vacuum filtrate. Sludge floc size had the greatest effect of those parameters tested on the rate at which metal hydroxide sludges dewater. Increases in the mean floc size of a sludge produced significant improvements in the rate of sludge dewatering, as evidenced by decreased sludge specific resistance values. Insolubility pH and variations in metal content altered sludged specific resistance by affecting the size of flocs formed during the precipitation phase of treatment. Synthetic polyelectrolytes condition metal hydroxide sludges through increases in particle size. The mechanism of polymer action appears to be interparticle bridging. (Baker-FRC) W82-00976

#### WATER QUALITY EVALUATION OF REGIONAL WASTEWATER MANAGEMENT, Toronto Univ. (Ontario). Dept. of Civil Engineering.

B. J. Adams, and R. S. Gemmell. Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EEE, p 437-450, April, 1980. 6 Fig, 13 Ref.

Descriptors: \*Wastewater management, \*Water quality control, Urban areas, Water treatment facilities, Wastewater facilities, Design criteria, Planning, Decision making.

Regional wastewater management alternatives are discussed in relation to size, number and location of wastewater treatment plants. A two-reaction model is used in the discussion. The model assumes that the flow is uniform and steady and that there is no longitudinal dispersion. This model can predict the dissolved oxygen deficit at any time of flow downstream due to a single point discharge. The deterministic analysis reveals that for a given stream size or dilution ratio and a given stream length, an increase in the disaggregation state of wastewater treatment plants results in an improved water quality. Water quality improvement resulting from a decentralized regional wastewater treatment system is also a function of the dilution ratio. It appeared that decentralization was more beneficial in cases with relatively small streamflows. The water quality impact of regional wastewater centralization due to stochastic variability was examined with stochastic simulation models. Increasing the state of aggregation or equivalently increasing the number of wastewater discharge points resulted in minimum dissolved oxygen frequency responses with smaller variances. Thus the multi-plant system resulted in a minimum stream dissolved oxygen level significantly larger than that of the single plant system. For systems of various lengths, increasing the stream length not only increased the mean minimum dissolved oxygen response, but also decreased the variance of the response of multiplant systems. It was concluded that the decentralized wastewater system significantly outperformed the centralized system when the dilution was small. As the dilution ratio increased, this difference in performance decreased. (Baker-FRC) W82-00977

**CHEMICALS DISINFECT SLUDGE,** Universidad Autonoma de Nuevo Leon, Monterrey (Mexico). A. Ramirez, and J. F. Malina, Jr. Water and Sewage Works, Vol 127, No 4, p 52-54, April, 1980. 4 Fig, 1 Ref.

Descriptors: \*Sludge disposal, \*Disinfection, Ozonation, Chlorination, Land disposal, Calcium hydroxide, Lime, Ammonium hydroxide, Sludge utilization, \*Wastewater treatment.

Ozone, chlorine, and calcium hydroxide plus ammonium hydroxide were considered in addition to calcium hydroxide (quicklime) alone as potential disinfectants of sewage sludge to be applied to land. Tests indicated that chlorine disinfection of sludge could produce organochlorinated substances which might pose a problem for the final disposal of treated sludge. Obnoxious odors may also develop when chlorine residuals disappear if sludge is stored in the liquid form. The addition of lime killed or inhibited bacteria, although the acid-fast bacteria demonstrated more resistance to the high pH treatment than to chlorination. A decrease in bacterial survival of up to 5.5 orders of magnitude could be maintained for several days at a lime dosage of 1.2-1.5 times that needed to produce an initial pH of 12. Ammonium hydroxide combined with a pH of 12 (achieved by lime addition) and homogenization was tested. This combination was more efficient for acid-fast bacteria removal than lime alone. Fecal streptococcus assays were similar to those produced using lime alone. Bacterial resistance to disinfection chemicals increased in the order of total coliforms < fecal coliforms < fecal streptococci < acid-fast bacteria. Thus fecal streptococcus and acid-fast bacteria are desirable indicators for sludge disinfection studies. (Baker-FRC) W82-01003

#### SCOTT BRINGS UNIQUE \$25-MILLION WASTE TREATMENT FACILITIES ON-LINE, K. E. Smith. Pulp and Paper, Vol 54, No 2, p 98-100, February, 1980. 1 Fig.

Descriptors: \*Pulp wastes, \*Activated sludge process, \*Wastewater treatment facilities, Pulp and paper industry, Wastewater treatment, Costs, Aerated lagoons, Water quality, Water pollution control, \*Mobile, Alabama.

A recently upgraded effluent treatment facility at a paper plant in Mobile, Alabama, includes an improved existing secondary treatment plant, new sludge dewatering equipment, and the construction of a unique 115-acre stabilization and aeration basin. The 25 million dollar project was necessary to meet EPA and future requirements. A static aeration system was added to the existing plant; the plant's effluent flows by gravity to a new 115 acre aeration and stabilization pond. Nine floating agitators aerate the effluent, which is eventually discharged into the Mobile River. Removal of the effluent discharge from Chickasaw Creek improved the appearance of the creek as well as water clarity, purity, and dissolved oxygen levels. (Small-FRC) W82-01007

#### MUTANT BACTERIA CONTROL FILAMENTOUS GROWTH IN MILL WASTEWATER TREATMENT, Polybac Corp., Allentown, PA. T. G. Zitrates. Pulp and Paper, Vol 54, No 2, p 172-174, February, 1980. 1 Tab.

Descriptors: \*Activated sludge process, \*Bacteria, \*Pulp wastes, \*Wastewater treatment, Pulp and paper industry, Biochemical oxygen demand, Performance evaluation.

Mutant bacteria can increase BOD<sub>5</sub> removal rates, improve sludge settling, and increase tannin and lignin removal in activated sludge plants treating pulp mill wastes. Seeding with single-cell, nonfilamentous, mutant bacteria can replace costly hydrogen peroxide and polymer treatments for the control of filamentous organisms. The mutant bacteria were tested in an integrated chemimechanical pulp and paper mill producing 160 air dry tpd of hydrogen-peroxide bleached hardwood pulp. The mill sends 6 million gal/day of wastewater to the treatment system. Successful pilot studies justified a trial of full-scale continuous control of filamentous growth. The seeding began with a dosage of 25 lb/million gal, and for the next ten days 30 lb/day were added, followed by a maintenance dosage of 9 lb/day. After 47 days, improvement in sludge settling was 41.9%, improvement in total BOD removal was 12.2%, and the biomass remained

healthy with minimum filamentous growth. (Small-FRC) W82-01008

#### NEW SECONDARY TREATMENT SYSTEM BROUGHT ON-LINE AT GEORGIA-PACIFIC, H. M. Cody. Pulp and Paper, Vol 54, No 7, p 180-182, July, 1980. 2 Fig, 1 Tab.

Descriptors: \*Pulp and paper industry, \*Secondary wastewater treatment, \*Stabilization lagoons, Effluents, Industrial wastes, \*Wastewater treatment, Aerated lagoons, Wastewater lagoons, Lagoons, Outfall, \*Puget Sound, Washington.

A \$20 million secondary treatment system (lagoon plus outfall/diffuser) was installed at the Georgia-Pacific Corporation's Bellingham, Washington, mill on Puget Sound to meet effluent standards. The system consists of a stabilization lagoon designed to treat 240 million gallons with continuous aeration at a flow design of 25 million gal per day. After a residence time of 7 days, effluent from the lagoon is combined with clean water in a chamber and discharged through a 60 in. i.d. outfall pipe at a design flow of 50 million gal per day. The diffuser section is 2000 ft long and has 500 1.5 inch diameter ports at 8 ft intervals, discharging at an average 55 ft below the surface. The average BOD load into the lagoon is 110,000 lb per day; the discharge limit is 22,500 lb per day. The total suspended solids output limit is 35,300 lb per day. (Cassar-FRC) W82-01009

#### SIMULATION MODELING OF PRIMARY CLARIFIERS, Paramount Engineering Ltd., Kitchener (Ontario). For primary bibliographic entry see Field 6A. W82-01027

REMOVAL OF VOLATILE TRACE ORGANICS FROM WASTEWATER BY OVERLAND FLOW LAND TREATMENT, Army Cold Regions Research and Engineering Lab., Hanover, NH. T. F. Jenkins, D. C. Leggett, and C. J. Martel. Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 211-224, 1980. 4 Fig, 3 Tab, 14 Ref.

Descriptors: \*Wastewater treatment, \*Land disposal, \*Organic wastes, Organic compounds, Chlorination, Chloroform, Toluene, Volatility.

The effectiveness of a prototype overland flow land treatment system in reducing the levels of volatile trace organics in municipal wastewater was investigated. Chlorinated primary wastewater, water collected from the surface at various points downslope, and runoff were analyzed by GC/MS using a purge and trap sampler. The primary settled wastewater was chlorinated before application to the grass covered slopes, by adding 2.0 liters of 5.25% sodium hypochlorite solution to a 5300 liter holding tank and mixing for one hour. Wastewater was applied to the test site at five different application rates ranging from 0.40 cm/hr to 2.31 cm/hr. Average hydraulic detention times on the slope were determined by chloride tracer analysis at each flow rate used. The period of application was seven hours per day, five days per week. After a steady state flow was established, samples were collected from the applied wastewater, surface water at various downslope distances, and runoff. Results indicated that efficient removals of a number of volatile substances including chloroform and toluene were achieved by this method. Loss of these substances was found to follow first order kinetics. The observed behavior is consistent with a volatilization process. (Baker-FRC) W82-01042

#### EFFECTS OF RENTON WASTEWATER TREATMENT PLANT EFFLUENT ON WATER QUALITY OF THE LOWER GREEN/DUWAMISH RIVER, Washington State Dept. of Ecology, Olympia. J. C. Bernhardt.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

In: *The Impact of Renton Wastewater Treatment Plant on Water Quality of the Lower Green/Duwamish River*, Document DOE 81-2. January 1981. Part I. 35 p. 13 Fig. 4 Tab, 17 Ref. Append.

Descriptors: \*Wastewater dilution, \*Stream pollution, \*Wastewater facilities, Wastewater treatment, Wastewater management, Wastewater disposal, Wastewater pollution, Waste discharge, Discharge hydrographs, Water quality standards, Water quality, On-site data collections, Washington, \*Seattle.

The Municipality of Metropolitan Seattle (METRO) completed the Renton Wastewater Treatment Plant (RWTP) in 1965 to improve water quality in Lake Washington and nearby areas. As the RWTP has grown, the Department of Ecology has become increasingly concerned about the possible impacts of the discharge on stream quality. Past investigators have concentrated mainly on the lower waterway and zone of salt water intrusion, while the fresh waters above have received limited attention. This report describes the dilution and dispersion of RWTP wastewaters and measurements of selected water quality constituents. Two time-of-travel surveys were conducted on the lower Green-Duwamish River to evaluate impacts of secondary-treated wastewaters discharged from the RWTP during summer low flow. The 12-mile section of the lower river between RWTP and Harbor Island at the mouth was drift-floated on two occasions. Two small surface drogues were placed in the river near the outfall. Stream quality was generally poor, and was associated mainly with RWTP. At 4:1 and 4:4:1, the stream-to-effluent dilution ratios were far below the 20:1 recommended minimum. Violations of state standards for temperature and dissolved oxygen were observed. EPA red book criteria for total residual chlorine and ammonia (un-ionized) were exceeded, while nitrite-nitrogen reached borderline levels. The ability of the Green-Duwamish River to assimilate wastewater discharged by RWTP appears to be exceeded at the current rate of discharge. Problems associated with the plant will increase as the plant approaches the 144 MGD ultimate site capacity. (Garrison-Omniplan) W82-01063

#### THE IMPACT OF EFFLUENT FROM THE RENTON WASTEWATER TREATMENT PLANT ON THE DISSOLVED OXYGEN REGIME OF THE LOWER GREEN/DUWAMISH RIVER,

Washington State Dept. of Ecology, Olympia.

W. E. Yake.  
In: *The Impact of Renton Wastewater Treatment Plant on Water Quality of the Lower Green/Duwamish River*, Document DOE 81-2. January 1981. Part II. 19 p. 8 Fig. 3 Tab, 12 Ref. Appendix.

Descriptors: \*Wastewater treatment, \*Dissolved oxygen, \*Model studies, \*Streeter-Phephus equation, Wastewater management, Wastewater disposal, Waste discharge, \*Wastewater pollution, Sludge, Inorganic compounds, Nitrification, On-site data collections, \*Seattle, Washington.

The Renton Wastewater Treatment Plant (RWTP) was completed in 1965 by the Municipality of Metropolitan Seattle (METRO) to improve water quality in Lake Washington and nearby areas. The Department of Ecology has become increasingly concerned about the possible impacts of the discharge on stream quality, especially since past investigators have concentrated on the lower waterway and zone of salt water intrusion rather than the fresh waters above. The RWTP is an activated sludge plant with an average daily dry weather flow of about 36 MGD. The flow from noon to 2 a.m. is about 50 percent greater than the average. A plant for upgrading the plant is being negotiated by METRO, DOE and EPA, and more data are needed. This report gives a detailed modeling analysis of the dissolved oxygen regime below the RWTP outfall. The model used a modification of the Streeter-Phephus equation which accounts for longitudinal dispersion. Rate constants and other variables were determined from data collected during two 24-hour drift surveys conducted in 1979. Dissolved oxygen concentrations below the plant discharge were depressed 2 to 3 mg/l. Based

on model results and interpretation of survey data, nitrification of effluent ammonia was found to be responsible for about 95 percent of the observed dissolved oxygen depression. During the study there was no evidence of in-plant nitrification; all inorganic nitrogen was discharged to the Green/Duwamish system as ammonia. Model extrapolation to 1985 suggests further substantial degradation of the lower Green/Duwamish River as plant flow increased and instream dilution ratios decrease. (Garrison-Omniplan) W82-01064

**WATER QUALITY CONDITIONS IN THE BELLINGHAM BAY AREA 1979-1980,**  
Washington State Dept. of Ecology, Olympia.  
For primary bibliographic entry see Field 5B.  
W82-01068

#### TREATABILITY MANUAL; VOLUME I. TREATABILITY DATA.

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
Available from Supt. of Documents, GPO, Washington, DC 20402 in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223050, Price code: A01 in microfiche only. Report EPA-600/8-80-042a, July 1980. 1089 p, 109 Fig, 642 Tab, 51 Ref.

Descriptors: \*Industrial wastewater, \*Wastewater treatment, \*Water pollution control, Pollutants, Effluents, Physical properties, Adsorption, Biodegradation, Toxicity, Hazardous materials, Metals, Ethers, Phthalates, Phenols, Hydrocarbons, Halogenated hydrocarbons, Pesticides.

This volume supplies treatability data on specific industrial wastewater pollutants, with physical data on the pollutants, their occurrence patterns, and methods of treatment and/or removal. Pollutants are grouped according to the following chemical categories: metals and inorganics, ethers, phthalates, nitrogen compounds, phenols, aromatics, polynuclear aromatic hydrocarbons, polychlorinated biphenyls and related compounds, halogenated hydrocarbons, pesticides, oxygenated compounds, and miscellaneous. Each pollutant is described as a pure species, with appropriate physical data, its concentrations in the wastewater streams in which it is detected, and its treatability/removability by standard treatment processes. Carbon absorption and biodegradability data are presented for organic compounds, and precipitation/coagulation properties are given for metals. The pollutants considered are the 129 toxic pollutants and 74 additional pollutants deemed a hazard to the aqueous environment. (Brambley-SRC) W82-01073

#### TREATABILITY MANUAL; VOLUME II. INDUSTRIAL DESCRIPTIONS.

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161, as PB80-223068, Price code: A01 in microfiche only. Report EPA-600/8-80-042b, July 1980. 986 p, 29 Fig, 685 Tab, 63 Ref.

Descriptors: \*Industrial wastewater, \*Wastewater treatment, Industrial plants, Effluents, Water pollution control, \*Waste characteristics, Wastewater facilities, Pollutants, Toxicity.

This volume characterizes the wastewater discharged by 22 industrial categories on a facility basis, prior to and after treatment. The pollution control methods used with the treated final effluent pollutant concentrations are also provided. Each industrial category is defined according to the Standard Industrial Classification Codes, and are divided into subcategories if the data are available. The total number of facilities in each category discharging an aqueous effluent to a receiving stream or a publicly owned treatment works is given in an industrial summary table. Wastewater characteristics are provided for each category or subcategory, and for separate processes when the

data are available. The specific plant descriptions generally include a treatment system description, plant production, and wastewater flow. Removability of the 129 toxic pollutants, conventional pollutants, and others achievable by currently used treatment systems is presented, with information on treatment methods and removal efficiencies. (Brambley-SRC)  
W82-01074

#### TREATABILITY MANUAL; VOLUME III. TECHNOLOGIES FOR CONTROL/REMOVAL OF POLLUTANTS.

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223076, Price code: A01 in microfiche only. Report EPA-600/8-80-042c, July 1980. 736 p, 73 Fig, 496 Tab, 70 Ref.

Descriptors: \*Industrial wastewater, \*Wastewater treatment, \*Water pollution control, \*Effluents, \*Sludge disposal, Toxicity, Hazardous materials, Pollution load, Industrial plants, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This volume presents performance data and related technical information for 56 unit operations used in industrial water pollution control. The operations include 24 sludge treatment and disposal technologies, 4 wastewater conditioning technologies, and 28 generic wastewater treatment technologies classified as primary, secondary or tertiary treatment based on the types of pollutants they are designed to remove. Emphasis is placed on the 28 water treatment technologies, with concentration and removal efficiency data given for conventional pollutants, the 129 toxic pollutants, hazardous substances, and other nonconventional pollutants of concern in specific industrial wastewaters. The treatment processes are described in general terms to provide an overview, but published information on influent and effluent pollutant concentrations, removal efficiencies, point source category, scale of treatment operation, location in overall treatment system, and design and operating parameters are given. Statistical summary tables for each primary, secondary, and tertiary wastewater treatment technology incorporate all effluent concentration and removal efficiency data contained in the plant-specific data base for that technology. (Brambley-SRC)  
W82-01075

#### TREATABILITY MANUAL; VOLUME IV. COST ESTIMATING.

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223084, Price codes: A01 in microfiche only. Report EPA-600/8-80-042d, July 1980. 402 p, 244 Fig, 166 Tab, 121 Ref.

Descriptors: \*Industrial wastewater, \*Wastewater treatment, \*Costs, Capital costs, Operating costs, Water conditioning, Sludge disposal, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This volume presents total capital investment and annual operating cost curves for 78 industrial wastewater treatment technologies. The technologies are categorized into six groups: wastewater conditioning; primary wastewater treatment; secondary wastewater treatment; tertiary wastewater treatment; sludge treatment; and disposal. The cost curves generally show costs in millions of dollars versus flowrate, and all costs have been indexed to September 1979. The estimates are valid only for comparison purposes, as they are generalized rather than site-specific and do not include land costs. The total capital investment is estimated to be 3.6 times the purchased equipment and installation cost, while the operating cost is the sum of labor, materials, chemicals, power and fuel costs and the indirect costs of overhead, taxes and insurance.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

ances, administrative expenses, depreciation, and interest. (Brambley-SRC)  
W82-01076

#### TREATABILITY MANUAL; VOLUME V. SUMMARY.

Environmental Protection Agency, Washington, DC. Office of Research and Development. Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223092, Price code: A01 in microfiche only. Report EPA-600/8-80-042, July, 1980. 177 p, 1 Fig, 10 Tab, 203 Ref, 4 Append.

Descriptors: \*Industrial wastewater, \*Wastewater treatment, \*Water pollution control, \*Effluents, Toxicity, Pollution load, Indicators, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This final volume on industrial wastewater treatment technologies includes summaries of the previous volumes and outlines their potential utility to National Pollutant Discharge Elimination System permit writers. Combinations of industrial processes and control technologies for which quantitative effluent data are available are listed. The median observed effluent concentrations for primary, secondary, and tertiary control technologies for conventional, toxic, and other pollutants and the median removal efficiencies for each technology are also given. A summary table presents the highest observed removal efficiency and the lowest observed effluent concentration for various pollutants as a function of the technology used to control the discharge. The EPA has recently allowed the use of indicator pollutants to control toxic pollutants and hazardous substances, where, by controlling a specified pollutant, other similar pollutants are assumed to be controlled. (Brambley-SRC)  
W82-01077

### SE. Ultimate Disposal Of Wastes

BETTER DEWATERING IMPROVES SLUDGE RECYCLING AND GIVES SIGNIFICANT ENERGY SAVINGS,  
Racine Wastewater Utility, WI.  
T. J. Bunker.  
Water/Engineering and Management, Vol 128, No 6, p 40-42, June, 1981. 2 Fig.

Descriptors: \*Sludge drying, \*Wastewater treatment, Water treatment facilities, Sludge, Sludge thickening, Dewatering, Recycling, Sludge disposal.

Belt presses were chosen to replace the vacuum filters previously used to reduce the amount of recycled solids being fed to the head of the wastewater treatment plant in Racine, Wisconsin. There were several reasons for this choice. First, the presses had the ability to remove more solids during the dewatering process. Second, their power requirements were substantially lower. The new units also produced a drier sludge cake with a solids concentration averaging 25%, compared to 15% for the vacuum filters. As a result of drier cakes, sludge handling costs were cut. Installation speed was also a consideration because of the recycling problem. Conditioned sludge is gently fed into a 7 foot gravity drainage section of the belt. Baffling devices disperse the sludge over the belt and form additional channels in the material for removal of ponded water. This free water is removed by gravity through openings in the polyester belt. Next the sludge is gently dropped to the lower of two pressure belts and becomes sandwiched between these belts to form a moving and adjustable wedge. Increasing pressure is applied by the belts as they pass through rollers of decreasing diameters, gradually forcing water from the moving wedge. The dewatered sludge is discharged on to a conveyor for transfer to a holding area where it is loaded on to a truck for ultimate disposal. (Baker-FRC)  
W82-00526

EFFECT OF LEACHATE FLOW RATE ON METAL MIGRATION THROUGH SOIL,  
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
B. A. Alešić, W. H. Fuller, and M. V. Boyle.  
Journal of Environmental Quality, Vol 9, No 1, p 119-126, January-March, 1980. 8 Fig, 8 Tab, 28 Ref.

Descriptors: \*Leachates, \*Flow rates, \*Metals, \*Migration, Leaching, \*Trace elements, Aluminum, Iron, Chromium, Beryllium, Solid wastes, Water pollution sources.

The influence of flux or flow rate of municipal solid waste leachate on the attenuation of selected trace elements was evaluated in some representative United States soils. Natural municipal solid waste leachates enriched with Be, Cd, Cr, Fe, Ni, and Zn were used in soil columns under anaerobic saturated conditions. Flow rates of leachate were regulated to deliver precise fluxes ranging from 1 to 15 ml/hr. Each hour, effluent was collected and analyzed for the metal ions studied. Generally, the slower the rate of flow of the solid-waste leachate, the greater the attenuation of metal ions. The attenuation of Al, Be, Cr(VI), and Fe(II) was significantly influenced by flux. The absolute amount retained by the soil was influenced to the greatest extent by the concentration of the metal in the leachate. Flow rate of leachates from solid waste disposal sites can be controlled by controlling flux. Renovating the soil, lining the excavation, and compacting the waste to known densities are possible control techniques. (Small-FRC)  
W82-00565

THE TOXIC WASTE DUMP PROBLEM AND A SUGGESTED INSURANCE PROGRAM,  
State Univ. of New York Coll. at Fredonia. Dept. of Economics.

A. Fisher.  
Boston College Environmental Affairs Law Review, Vol 8, No 3, p 421-461, 1980. 138 Ref.

Descriptors: \*Hazardous materials, \*Waste dumps, \*Insurance, Toxins, Legal aspects, Safety, Landfills, \*Waste disposal, Economic aspects, Environmental effects.

A National Hazardous Waste Insurance Program is discussed, and existing and pending legislation related to toxic waste disposal is reviewed. Available knowledge about the number and location of toxic waste sites and estimates of cleanup costs is presented. The environmental policy suggested here is similar in rationale and structure to the National Flood Insurance Program. It would give potential victims the opportunity to protect themselves from hazardous waste damages through the purchase of federally subsidized insurance. This could reduce disaster relief payments and promote development planning focused on reducing the chance of toxic waste damage. New York's Love Canal, Kentucky's Valley of the Drums, and North Carolina's 210 miles of PCB-contaminated highways are examples of hazardous waste disasters. The shortcomings of dump and landfill disposal of chemical wastes are highlighted by the Love Canal episode. (Small-FRC)  
W82-00591

BENTONITE LINERS FOR POWER PLANT LAGOONS,  
West Virginia Univ., Morgantown.

F. J. Calzonetti.  
Power Engineering, Vol 84, No 3, p 61-62, March, 1980. 1 Fig, 2 Tab.

Descriptors: \*Lagoons, \*Bentonite, Linings, Wastewater lagoons, \*Powerplants, \*Waste disposal.

Waste disposal facilities to handle power plant wastes must be designed and sited so that ground and surface water resources are not contaminated. The Resource Conservation and Recovery Act of 1976 (RCRA) designates wastes as either hazardous or solid, and defines treatments accordingly. The use of natural clays as inexpensive and effective liners to control the seepage of leachates from

energy facility waste ponds and lagoons is permissible. Alternatives such as synthetic membranes are commonly used, but do not appear as effective as natural clays. One particular clay, bentonite, has been the subject of much attention due to its swelling properties and ability to increase soil impermeability. Bentonite is a variety of montmorillonite clay, which was formed from volcanic ash and occurs in commercial quantities in Wyoming, Montana and South Dakota. The clay has exchangeable sodium ions and when wetted swells 15 to 20 times in volume. It is currently used across the nation for lagoon lining purposes. Untreated bentonite sells for \$50 to \$60 a ton plus transportation charges. The soil texture of the site and the transport costs incurred in shipping bentonite from Wyoming to the energy facility are prime determinants of the cost of using bentonite filters. (Baker-FRC)  
W82-00617

#### TRACE ELEMENT ACCUMULATION, MOVEMENT, AND DISTRIBUTION IN THE SOIL PROFILE FROM MASSIVE APPLICATIONS OF SEWAGE SLUDGE,

California Univ., Berkeley. Dept. of Soils and Plant Nutrition.  
D. E. Williams, J. Vlaminis, A. H. Pukite, and J. E. Corey.  
Soil Science, Vol 129, No 2, p 119-132, February, 1980. 7 Fig, 5 Tab, 73 Ref.

Descriptors: \*Trace elements, \*Land disposal, \*Sludge disposal, Accumulation, Barley, Heavy metals, Cadmium, Zinc, Lead, Copper, Soils, \*Path of pollutants.

Sewage sludge was applied three times annually to soil on which barley was grown. One sludge was a wet cake type with a considerable amount of heavy metals, while the second air-dried sludge was primarily domestic in origin. Application rates varied from 0 to 225 metric tons/ha/yr, and the sludges were mixed into the surface 20 cm of soil. In general, sludge application was found to increase the amounts of HNO<sub>3</sub>-extractable heavy metals. DTPA extracts indicated that Cd, Zn, Pb, and Cu were highly available; Mn, Co, and Ni were moderately to slightly available; and Fe and Cr were relatively unavailable. When sludge high in metals was added, increased metal content and metal movement were limited to a depth of 30 cm, which was 10 cm below the area of sludge incorporation. The wet sludge cake resulted in increased acidity of the soil, but metal availability was not increased by this acidity. (Small-FRC)  
W82-00640

EFFECT OF IRRIGATING LOAMY SAND SOIL BY LIQUID SEWAGE SLUDGE ON ITS CONTENT OF SOME MICRONUTRIENTS,  
Ain Shams Univ., Cairo (Egypt). Dept. of Soils. F. M. Abdou, and M. El-Nennah.  
Plant and Soil, Vol 56, No 1, p 53-57, 1980. 2 Tab, 12 Ref.

Descriptors: \*Wastewater irrigation, Wastewater farming, \*Metals, Liquid sludge, Organic matter, Zinc, Iron, Manganese, Nutrients, Land disposal.

The effect of irrigating loamy sand soil of the El-Gabal El-Asfar area near Cairo with liquid sewage sludge was investigated for some micronutrients in these soils. Levels of Zn, Fe, and Mn were determined in soils thus irrigated for 2, 25, 35, and 45 years. Sewage sludge irrigation increased both the CEC (cation exchange capacity) and organic matter content of the tested soils. There was a marked increase in the easily soluble forms of Zn, Fe, and Mn. Thus, the sludge could be used as a plant nutrient source or as a soil improver. However, the increase of these metals in soil may decrease the activity of some soil enzymes and disturb the N-mineralization. Agricultural areas irrigated with sludge must be monitored for increased levels of Pb, Cd, and Hg, even though there have been no symptoms of toxicity observed on plants growing at the current disposal site. (Small-FRC)  
W82-00661

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Treatment and Quality Alteration—Group 5F

**PERSISTENCE AND DISTRIBUTION OF ERY-SIPELOTHRIX RHUSIOPATHIAE AND BACTERIAL INDICATOR ORGANISMS ON LAND USED FOR DISPOSAL OF PIGGERY EFFLUENT,**  
Victoria Dept. of Agriculture (Australia).  
Attwood Veterinary Research Lab.  
For primary bibliographic entry see Field 5B.  
W82-00686

**DAIRY LIQUID WASTE DISTRIBUTION IN AN OVERLAND FLOW VEGETATIVE-SOIL FILTER SYSTEM,**  
Southern Illinois Univ. at Carbondale. Dept. of Agricultural Industries.  
For primary bibliographic entry see Field 5D.  
W82-00897

**POTENTIAL FOR LAND DISPOSAL OF TWO NONBIODEGRADABLE WASTES,**  
Delaware Univ., Newark. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 5D.  
W82-00939

**EXTRACTING HEAVY METALS AND TOXIC ORGANICS FROM SLUDGE,**  
For primary bibliographic entry see Field 5D.  
W82-00947

**COMPOSTING IS WORKING IN CAMDEN,**  
Camden County Municipal Utilities Authority, NJ.  
J. D. Ochs.  
Water/Engineering and Management, Vol REF, No HB, p R138-140, 1981.

Descriptors: \*Composting, Pilot plants, \*Sludge disposal, Land application, Camden, \*New Jersey, Sludge, Bulking sludge, Cost analysis.

A pilot plant was constructed in Camden County, New Jersey, to study whether composting is a good solution for Camden's sludge disposal problem. Early in the planning stage of the composting operation, the basic objective of the program had to be defined. The process was designed to make a product for multiple uses. These uses are enhanced if the plant nutrient/soil structure properties are maximized, and attempts have been made toward that end in this particular program. The compost facility can handle 26 dry tons per day, or 104 wet tons of 25% solids, operating on a two ton shift, five days per week schedule. Raw primary sludge is accumulated in a day holding tank. Moyno sludge pumps feed the 5% solids sludge to two of three Carter belt-filter presses. The third press is for standby use. The dewatered sludge is discharged to a conveyor which transports it over an automatic scale. The scale signals an automatic woodchip feeding system to regulate the ratio of bulking material added to the sludge. The composting process involves laying down a pile of woodchip/sludge mixture onto perforated iron pipes that have been covered with a layer of new woodchips about 1.5 to 2 ft deep and about 7 ft wide. Each pile is aerated for a minimum of 21 days. One of the primary cost factors in the process is the purchase of woodchips. One of the principal users of the compost to date has been a large commercial greenhouse operation. (Baker-FRC)  
W82-00948

**EVALUATION OF WINTER APPLICATION OF LIQUID SLUDGE TO FARMLAND,**  
Guelph Univ. (Ontario). Dept. of Land Resource Science.  
For primary bibliographic entry see Field 5B.  
W82-00952

**TRENCHING OF DIGESTED SLUDGE,**  
Science and Education Administration, Beltsville, MD.  
L. J. Sikora, N. H. Frankos, C. M. Murray, and J. M. Walker.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil

Engineers, Vol 106, No EE2, p 351-361, April, 1980. 5 Tab, 18 Ref.

Descriptors: \*Sludge disposal, \*Trenches, Ditches, Nitrogen, Sludge digestion, Sludge cake, Sludge, Wastewater, \*Leaching, Chlorides, Salts, Metals, Chemical analysis.

In trenching digested sludge, a sludge filter cake of about 20% solids is placed in trenches about 2 feet wide by 2.5 feet deep and 2 feet apart. Trenches are filled to about 80% of capacity with sludge and covered with soil from adjacent, recently dug trenches. The environmental effects of trenching were studied using varying size trenches, types of sludge and soil types. The plots containing the digested sludge trenches were located in a loamy sand of the Galestown-Evesboro series. One tillage practice studied involved leaving mounds over the trenches intact. A second treatment involved leveling and disk the area. A third treatment involved leveling and cross ripping perpendicular to the trenches with ripper shanks. Much of the chloride initially present in the sludge was leached into the profile during the first year. After 4 years nearly all the chloride was leached. More nitrogen was leached during the first two years than during the next two, with the predominant nitrogen form found in the soil being ammonia-nitrogen. After four years the sludge in the trench was near or at stabilization. The amount of mineralizable nitrogen in the sludge was low, with soil profiles having low levels of inorganic nitrogen and chloride. Zinc was the only metal found in detectable levels in the soil beneath the trenches. The amount of zinc leached was minor compared with the total zinc concentration in the entrenched sludge. Environmental effects would be primarily felt on the groundwater. The severity of the effect would be site specific, depending on soil type, depth of ground water, infiltration rate, and sludge type. (Baker-FRC)  
W82-00974

**A SIMULATION MODEL FOR SLUDGE DECOMPOSITION IN SOIL,**  
Arkansas Univ., Fayetteville. Dept. of Agronomy. J. T. Gilmour, and C. M. Gilmour.  
Journal of Environmental Quality, Vol 9, No 2, p 194-199, April/June, 1980. 3 Fig, 3 Tab, 14 Ref.

Descriptors: \*Model studies, \*Sludge disposal, \*Decomposition, Mathematical studies, Waste disposal, Simulation analysis, Soil amendments, Sludge, Soil water, Soil temperature, Sludge digestion, \*Carbon, Carbon dioxide.

A computer model called SLUDGE was designed to calculate the amount of sludge carbon compounds converted to CO<sub>2</sub>-C as a function of time for a single sludge addition incorporated into a medium-textured soil. As the type of C source undergoing decomposition varied and the temperature and water content changed, the rate constant of the expression was modified. During the rapid decomposition phase, the paradigm computes decomposition on a daily basis, and during the slow phase, on a monthly basis. The model was tested using synthetic sludge decomposition data and decomposition data for municipal sludge. Fifty percent of the municipal sludge was decomposed over a 32- to 57-month period. Yearly soil temperature and water content averages gave less accurate predictions than monthly data when used in the model. Laboratory optimum conditions gave shorter sludge half-life times than did field conditions. When the model was modified to include annual June additions of sludge, the ratio of accumulated sludge to an annual addition was from 4.3 to 7.9 after 50 yr. These ratios were greater than those computed by equations designed to calculate such ratios under constant soil conditions. (Geiger-FRC)  
W82-01001

**CHEMICALS DISINFECT SLUDGE,**  
Universidad Autonoma de Nuevo Leon, Monterrey (Mexico).  
For primary bibliographic entry see Field 5D.  
W82-01003

**DISSOLUTION OF SALT DEPOSITS BY BRINE DENSITY FLOW,**  
New Mexico Univ., Albuquerque. Dept. of Geology.

For primary bibliographic entry see Field 2F.  
W82-01016

**DREDGING AND DISPOSAL OF TOXIC MATERIAL USING JAPANESE TECHNOLOGY SUGGESTED FOR UNITED STATES,**  
F. T. Wooton.  
World Dredging and Marine Construction, Vol 16, No 4, p 14-15, April, 1980.

Descriptors: \*Dredging, \*Hazardous materials, \*Technology, Toxins, Japan, Spoil banks, Ocean dumping, Waste management.

The maintenance of navigation channels and harbors in Virginia is becoming extremely difficult due to the lack of dredging technology in the United States. Dredging activities will continue to be limited unless dredging and disposal methods which comply with existing environmental standards are developed. Currently, the extent and type of dredging which can be performed is determined by the pollutants in the rivers and harbors. Dredging and disposal methods used in Japan were investigated as part of an effort to develop alternative strategies for this project. The Japanese have made significant advances in the dredging field in order to eliminate severe pollution problems in their harbors. A dredge called the 'Oozer' has been developed which dredges about 80 percent solids and 20 percent water, compared to almost exactly opposite proportions dredged by a typical hydraulic dredge in the United States. In Japan, polluted dredged material is treated prior to disposal. A soil fixation process has also been developed which locks pollutants to the material being dredged and solidifies the dredged material in only a few days. This process, called the Takenaka Sludge Treatment, can be performed in a disposal area which can later be used for industrial development. The 'Oozer' appears to be capable of dredging most areas of the James River and its tributaries, as well as other areas polluted by toxic substances. (Carroll-FRC)  
W82-01026

### 5F. Water Treatment and Quality Alteration

**WHAT CAUSED THE BAD ODOR IN THE DRINKING WATER,**  
Williamsport Sanitary Authority, PA.  
M. H. Gerardi, and M. B. Gerardi.  
Water/Engineering and Management, Vol 128, No 6, p 63-65, June, 1981. 3 Tab.

Descriptors: \*Drinking water, \*Odors, Chemical analysis, Organic compounds, Water analysis, Bacteria, Temperature effects, Reservoirs, Potable water, Acidity, Heated water, \*Odor removal, \*Home water heaters, Williamsport, Pennsylvania.

Drinking water supplies for about 60,000 people in the Williamsport, PA area and several adjacent communities come from two 350 mg capacity reservoirs and a well field. During February of 1980 numerous complaints were made about a fishy or rancid odor present in the tap water supply. The odor was associated with the Hagerman Reservoir, was present only in hot water, was most objectionable in water drawn from hot water tanks which had a thermostat setting of at least 140 degrees F, and was most evident to consumers who drew from their hot water tanks in the morning and then not again until the evening, allowing the hot water in the tank to stand for 8-10 hr before use. Investigation indicated that a rancid odor was produced by *Nocardioides* species of bacteria at pH 8.5 and 140 degrees F on Standard Methods Agar and Dextrose Tryptone Agar. Samples containing the rancid odor were analyzed. Organics identified included unsaturated and saturated aliphatic esters and ketone, amide, and carboxylic acid salts. To correct the problem customers were asked to reduce their thermostat settings to 120 degrees F. Within two days a reduction in odor was noted by

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customers who complied with this request. To control Nocardia growth the pH of Hagerman Reservoir water was decreased by discontinuing the addition of soda ash. (Baker-FRC)  
W82-00527

#### CHRYSTOTILE ASBESTOS FIBER REMOVAL DURING POTABLE WATER TREATMENT, PILOT PLANT STUDIES,

Ontario Ministry of the Environment, Toronto. R. B. Hunsinger, K. J. Roberts, and J. Lawrence. Environmental Science and Technology, Vol 14, No 3, p 333-336, March, 1980. 2 Fig, 2 Tab, 10 Ref.

Descriptors: \*Water treatment, \*Asbestos, Turbidity, Filtration, Coagulation, Sedimentation, \*Drinking water, Water analysis, Potable water.

Various pretreatment and filtration processes for chrysotile asbestos fiber removal from surface water were evaluated at a pilot scale treatment facility equipped with full process control. In the majority of cases filtration significantly reduced the amount of asbestos in the water from that which was encountered in the postsedimentation samples. Fiber concentrations in the finished waters were below 1,000,000 fibers/liter in all but two of the cases and below 500,000 fibers/liter in 76% of the cases. The dual media filters produced an effluent that was superior to the sand filter effluent in terms of turbidity. The actual asbestos fiber counts also reflected the superiority of the dual media filters. There does not appear to be any direct relationship between the initial and final asbestos fiber concentrations across the process. However, from a general examination of the data it is apparent that the asbestos concentrations in the filter effluents are lower than those in the raw or postsedimentation water, indicating that conventional treatment processes are effective in reducing chrysotile concentrations. The lack of a specific relation between initial and final concentrations could be due to either inconsistencies in the unit processes or inherent inaccuracies in the analytical methodology. It was concluded that objective predictions and/or decisions regarding treatment efficiency are presently impossible given the current state-of-the-art in counting technology. Consistent quantitative analysis of chrysotile asbestos fibers in river water following fortification with a concentrated chrysotile asbestos suspension could not be obtained. (Baker-FRC)  
W82-00613

#### COAL TAR COATINGS OF STORAGE TANKS, A SOURCE OF CONTAMINATION OF THE POTABLE WATER SUPPLY,

New York State Dept. of Health, Albany. Div. of Lab. and Research.

For primary bibliographic entry see Field 5B.

W82-00616

#### WATER-TREATMENT CHEMICALS,

S. Miller.

Environmental Science and Technology, Vol 14, No 8, p 914-915, August, 1980.

Descriptors: \*Water treatment, \*Chemical treatment, Wastewater treatment, Chemical properties, Chemical reactions, Toxicity, Coagulation, Disinfection, Oxidation, Dispersants, Chemical coagulation, Catalysts, Water softening, \*Water supply, Drinking water.

Nine experts from various areas of water supply, water treatment, toxicology, chemistry, engineering, analytical testing, and manufacturing procedures have been called upon by the National Academy of Sciences (NAS) to serve as a committee to examine the approximately 60 bulk chemicals used in the treatment of drinking water. The chemicals used in water treatment can be roughly divided into four major categories: coagulants and flocculants, disinfectants and oxidizers, precipitants and softeners, and miscellaneous reagents. The committee will attempt to establish guidelines for the use of these chemicals and to establish analytical tests for impurities in the bulk chemicals themselves. The ultimate product from this committee is envisioned to be a manual something like the Food

Chemical Codex of 1974. Potential health problems are posed by the presence of chloroform in chlorine used for disinfection, presence of fluorides and arsenic in phosphates, heavy metal contamination, manganese and lead impurities in iron salts, and organic contaminants in polymeric coagulant aids. (Baker-FRC)  
W82-00618

#### ADSORPTION ON CARBON: SOLVENT EFFECTS ON ADSORPTION,

S. Miller.

Environmental Science and Technology, Vol 14, No 9, p 1037-1040, 1042, 1045-1049, September, 1980. 8 Fig, 8 Tab.

Descriptors: \*Solvents, \*Adsorption, \*Carbon, Solvophobic theory, \*Water treatment, Wastewater treatment, Pollution control, Activated carbon, Adsorbents, Surface tension.

Attempts to include the solvent and its surface tension in equilibrium adsorption formalism are discussed. A semiempirical quasitheoretical approach based on partial solubility parameters called the net adsorption energy approach is presented. A general comprehensive solution interaction approach recently adapted to the adsorption of organic homologues from dilute aqueous solutions is presented. The ability to predict the effects of even simple structural modifications on the adsorption of organic molecules from dilute aqueous solutions onto activated carbon or other adsorbents could be of great value in the design and operation of large-scale commercial water or waste water treatment plants. At present attempts are being made to apply the solvophobic theory for correlating the removal of homologous organic compounds by widely different unit processes such as adsorption, hyperfiltration, and biological metabolism. Solvent interactions are significant in these as well as many other processes. (Baker-FRC)  
W82-00645

#### MANAGEMENT TRAINING IS THE KEY TO GOOD OPERATOR PERFORMANCE,

For primary bibliographic entry see Field 5D.

W82-00623

#### ENVIRONMENTAL HEALTH HAZARDS,

S. Miller.

Environmental Science and Technology, Vol 14, No 6, p 648-651, June, 1980. 1 Fig.

Descriptors: \*Drinking water, \*Public health, Organic compounds, Disinfection, Chlorine, Activated carbon, Toxicity, Epidemiology, Human diseases, Cancer, Regulations, \*Hazardous materials.

The National Academy of Sciences (NAS) has organized a Board on Toxicology and Environmental Health Hazards. This board serves the federal government, particularly regulatory agencies, by providing comprehensive documents on pollutants and risk assessments of hazardous agents and studies of scientific concepts underlying interpretation of toxicologic and epidemiologic data. The Safe Drinking Water Committee started its review of adverse health effects attributable to contaminants in drinking water in the fall of 1975. In late 1977 the first NAS report, 'Drinking Water and Health,' a 939 page document, was published. Volumes II and III have since appeared. Volume II deals with disinfection of drinking water, chemistry of disinfectants in water, and an evaluation of granular activated carbon for drinking water treatment. Volume III considers epidemiological studies of cancer frequency and certain organic constituents of drinking water, problems of risk assessment, toxicity of selected drinking water contaminants, and contributions of drinking water to mineral nutrition of humans. (Baker-FRC)  
W82-00625

#### ANTIBIOTIC-RESISTANT BACTERIA IN DRINKING WATER,

Oregon State Univ., Corvallis. Dept. of Microbiology.

J. L. Armstrong, D. S. Shigeno, J. J. Calomiris, and R. J. Seider.

Applied and Environmental Microbiology, Vol 42, No 2, p 277-283, August, 1981. 4 Fig, 1 Tab, 35 Ref.

Descriptors: \*Drinking water, \*Bacteria, \*Drugs, Water quality, Public health, Pathogenic bacteria, Raw water, Water distribution.

The prevalence of drug-resistant bacteria in treated drinking waters and their relationships to multiple antibiotic resistant (MAR) bacteria in the raw source water were investigated. Drinking water from seven communities was sampled and analyzed for MAR bacteria. The MAR bacteria isolates obtained were screened against five antibiotics by replica plating. MAR bacteria made up 33.9% of 2653 standard plate count bacteria from the treated water. In two of the raw water supplies, MAR standard plate count bacteria were carried at frequencies of 20.4 and 18.6%, while levels in the respective treated waters were 36.7 and 67.8%. The following were more common in treated than untreated waters: gram-positive cocci and gram-negative, nonfermentative rods. Site-to-site variations indicated that the shedding of MAR bacteria living in pipelines may influence the populations found in tap water. The treatment of raw water and its subsequent distribution select for standard plate count bacteria exhibiting the MAR phenotype. (Small-FRC)  
W82-00645

#### EFFECT OF OZONATION AND CHLORINATION ON THE MUTAGENIC POTENTIAL OF DRINKING WATER,

Florence Univ. (Italy), Inst. of Pharmacology. For primary bibliographic entry see Field 5A.  
W82-00649

#### ACUTE AND CHRONIC EFFECTS OF ALUM TO MIDGE LARVA (DIPTERA: CHIRONOMIDAE),

Kennedy (Michael), Spokane, WA.

D. S. Lamb, and G. C. Bailey. Bulletin of Environmental Contamination and Toxicology, Vol 27, No 1, p 59-67, 1981. 1 Fig, 18 Ref.

Descriptors: \*Alum, \*Aquatic insects, \*Toxicity, \*Water treatment, Mortality, Fish food, Lakes, Assay, \*Eutrophic lakes.

In view of the increasing use of alum to precipitate phosphorus in highly eutrophic lakes, the acute and chronic effects of alum to *Tanytarsus dissimilis*, important fish food organisms, were determined. Acute tests used alum concentrations of 80, 160, 240, 320, 400, 480, 560, 720, and 960 mg/liter. Chronic test solutions contained 10, 80, 240, 480, and 960 mg/liter of alum. In acute tests there was no apparent effect of alum on either second or third instar *T. dissimilis* at doses between 80 and 960. Mortalities in the chronic assay were found at all alum doses. Fifty percent mortality was reached with 480 mg/liter at four days. The 50% mortality time for 80 and 240 mg/liter was between 8 and 10.5 days. At 960 mg/liter, 50% of the larvae were dead after 23 days. Heavy alum floc at 960 mg/liter appeared to cause a stress by impeding movements and feedings. Possible chemical and physical toxicity of alum must be considered when planning lake treatments. A well planned alum treatment will avoid adverse effects on the benthic insect population. (Small-FRC)  
W82-00650

#### FLOCCULATION OF CLAY PARTICLES WITH A SYNTHETIC ANIONIC POLYMER,

Amsterdam Public Works (Netherlands).

R. R. Kruize.

Effluent and Water Treatment Journal, Vol 21, No 5, p 205-209, May 1981. 5 Fig, 9 Ref.

Descriptors: \*Flocculation, \*Polymers, \*Clays, Turbidity, \*Water treatment, Salts, Coagulation, Superfloc A-100, Adsorption, Particulate matter.

A synthetic anionic polymer, Superfloc A-100, was tested in the coagulation step of drinking water treatment using a model suspension of Winsumclay

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in jar tests. Maximum flocculation (78%) occurred at 0.2-0.3 mg polymer per liter. Salt is necessary for the flocculation process. Speed of stirring higher than  $G = 60$  per sec destroys already-formed flocs. At higher concentrations of clay, less polymer is needed to achieve the same results. At low clay concentrations sludge recirculation can improve flocculation. Higher cation valency ( $\text{NaCl}$ ,  $\text{CaCl}_2$ , and  $\text{La}(\text{NO}_3)_3$ ) decreases the amount of salt necessary and increases maximum coagulation. Decreasing pH improves flocculation and adsorption. (Cassar-FRC) W82-00773

#### REMOVAL OF NITRATE FROM PUBLIC WATER SUPPLY ABSTRACTS,

Anglia Water Authority (England).

L. A. Greene.

Effluent and Water Treatment Journal, Vol 21, No 4, p 161-165, April, 1981. 10 Ref.

Descriptors: \*Nitrates, \*Ion exchange, \*Denitrification, Reverse osmosis, \*Water treatment, Rivers, Sludge disposal, Pretreatment, Anglia, \*Great Britain.

A review is presented on research being carried out in Anglia on treatment methods for the control of nitrate levels in public water supplies. Continuous ion exchange plants operating under optimal conditions can effectively reduce nitrates, but skilled maintenance is required in these plants. Fixed-bed nitrate removal plants operating under counter flow regeneration conditions can produce water with acceptable nitrate levels. If the shells are regenerated before nitrate breakthrough, sulfate, bicarbonate, and chloride can be removed sufficiently. Effluent disposal has been a problem; reverse osmosis can be employed to reduce the volume of effluent by 35-40%. Spiral wound reverse osmosis can concentrate effluent by 85%. Application of biological denitrification to full-scale river abstraction is being studied. Denitrification can be monitored by an automated monitor system preceded by a continuous sample system. The pretreatment plant can use methanol as the carbon source or ion exchange pilot columns. These techniques can also be applied to pumped storage impoundments. (Small-FRC) W82-00774

#### MANGANESE DIOXIDE AS AN ADSORBANT FOR HEAVY METALS,

West Kent Water Co. (England).

M. J. Gray.

Effluent and Water Treatment Journal, Vol 21, No 5, p 201-203, May, 1981. 1 Tab, 32 Ref.

Descriptors: \*Manganese dioxide, \*Adsorption, \*Heavy metals, Metals, Zinc, Cadmium, Cobalt, Nickel, Cations, Radioactive wastes, \*Wastewater treatment, Water treatment, Monitoring, Chemical properties.

The surface properties, adsorption of cations, and possible uses of manganese dioxide in water treatment are discussed in this review. In natural waters  $\text{MnO}_2$  has a strong negative charge, capable of adsorbing cations, and a large surface area, up to 800 sq meters per g. Heavy metal ions are adsorbed in decreasing order:  $\text{Mn}(2+)>\text{Zn}(2+)>\text{Cd}(2+)>\text{Co}(2+)>\text{Ni}(2+)$ . Adsorption is greater and less reversible for heavy metals than for alkali earth metals. Adsorption of cations increases with increasing pH and increasing temperature. Possible applications of the properties are: monitoring trace elements in water distribution systems through nodule and deposit formation; removal of  $\text{Cs}_{137}$ ,  $\text{Ce}_{131}$ ,  $\text{Sr}_{90}$ , and  $\text{Ra}$  from aqueous solutions; coprecipitation with radioactive wastes to minimize leaching; and removal of Cd in water and wastewater treatment. (Cassar-FRC) W82-00775

#### INTERACTION OF ORTHOPHOSPHATE WITH IRON (III) AND ALUMINUM HYDROXIDES,

Techische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Engineering.

For primary bibliographic entry see Field 2H.

W82-00783

#### POINT-OF-USE WATER TREATMENT...AN ENLARGING REALITY.

For primary bibliographic entry see Field 10D. W82-00784

#### ASSESSMENT OF SOME AQUEOUS RESIDUAL CHLORINE MEASUREMENTS,

Environmental Health Directorate, Ottawa (Ontario).

R. Olson, and D. T. Williams.

Bulletin of Environmental Contamination and Toxicology, Vol. 24, No. 2, p 251-256, 1980. 1 Fig, 2 Tab, 6 Ref.

Descriptors: \*Chlorine, \*Water sampling, \*Monitoring, \*Water treatment, \*Residual chlorine, \*Portable water, Organic carbon, Carbon, Experimental design, Drinking water, Water purification, Sewage effluent, Residual chlorine, Storage.

Sodium hypochlorite solutions, filter, plant effluent, and tap water were analyzed by the amperometric titration, residual chlorine electrode, and ferrous titrimetric methods, and the results were compared for the range 0.2 to 2.0 ppm residual chlorine. Overall precision for measurements by all three methods and in three laboratories was within 20 percent. Amperometric titration is the preferred method because of precision of measurements, simplicity of operation, and capability for multiple determinations. (Titus-FRC) W82-00867

#### THE REMOVAL OF ORGANIC MATTER FROM DEMINERALISED WATER,

Central Electricity Generating Board (England).

Northwestern Region.

G. Knowles, and K. Title.

Effluent and Water Treatment Journal, Vol 20, No 7, p 317-319, 321-322, July, 1980. 4 Fig, 5 Tab.

Descriptors: \*Ion exchange, \*Organic matter, \*Condensates, Water treatment, \*Water purification, Anion exchange, \*Powerplants, Activated carbon, Water quality, Fouling, Pretreatment of water.

Organic fouling of ion exchange resins caused serious reduction in efficiency in a powerplant condensate purification plant. The source of organic matter was makeup water with levels of 0.2-1.0 mg per kg total organic carbon. Organic removal was studied at 4 stages of purification—pretreatment, anion resin beds, scavenger beds at the water plant inlet, and polishing beds at the outlet. An attempt to pretreat the makeup water with sand filtration and alum achieved only a 14.3% removal and placed an extra burden on the anion exchange unit. In the anion beds organic matter was anion exchanged onto the resin and subsequently was displaced by stronger anions. Retained organic matter was on the order of 0.42-0.46 kg per cu m of resin, as expected. No real difference was seen in the performance of the presently used anion resin, FFIP, and the 2 possible alternatives, IRA 900 and IRA 458. Use of scavengers, IRA 904 (a strong base anion resin) followed by Zerolit 225 (a cation bed), prior to the anion exchange was disappointing because removal efficiency was 78-80% at the anion outlet compared with 88% when the scavenger was bypassed. Although activated carbon as a scavenger removed 95% of organic matter up to the passage of 1800 bed volumes, its efficiency deteriorated to 50% after 6000 bed volumes. Polishing beds of activated carbon produced 50% removal or less after about 3000-15,000 bed volumes. A Type 1 resin, OH(-) form IRA 938, removed 60-67% of organic matter with regeneration every 4000 bed volumes. The advantages, disadvantages, and cost estimates of the 3 most likely options (activated carbon at the treatment plant inlet, activated carbon at the mixed bed outlet, or IRA 938 at the mixed bed outlet) were evaluated. Tests are underway to determine if IRA 938 has an operating life of at least 1.5 years, the break-even point. (Cassar-FRC) W82-00946

#### REMOVING TRIHALOMETHANES FROM DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH.

J. M. Symons, A. A. Stevens, R. M. Clark, E. E. Geldreich, and O. T. Love, Jr.

Water/Engineering and Management, Vol 128, No 7, p 50, 52, 53, 56, 61-64, July, 1981. 1 Tab, 11 Ref.

Descriptors: \*Trihalomethanes, \*Chlorination, \*Disinfectants, Standards, Drinking water, \*Water treatment, Chlorinated hydrocarbons, Organic compounds, Humic acids, Ozonation, Chlorine dioxide, Aeration, Activated carbon, Adsorption, Clarification, Filtration, Costs, Residual chlorine.

Eleven treatment techniques for controlling trihalomethanes in drinking water are summarized in tabular form, listing treatment name, degree of

Water Treatment Plant, Traverse City, MI.

R. Bowen.

Water/Engineering and Management, Vol 128, No 7, p 30-33, July, 1981. 1 Fig, 2 Tab.

Descriptors: \*Turbidity, \*Filter media, \*Direct filtration, Water treatment, Alum, Raw water, \*Traverse City, Michigan, Lake Michigan, Coagulation, \*Filtration, Water treatment facilities.

A detailed study at the Traverse City, Michigan, water treatment plant led to the conclusion that treating the stable, low turbidity (average 0.6 NTU) raw water by direct filtration was superior to conventional treatment. Filters in the plant were: two dual-media (coal and sand) and one mixed-media (coal, sand, and garnet). Without alum addition, the mixed-media filter was superior. As alum dosage neared the optimum, mixed-media filtration was only slightly better than that with the dual-media filter. It was difficult to determine the optimum alum dosage, and residual alum was a problem. Temperature was critical to the filter run length. Runs were shorter at 36-38 F than at higher temperatures. (Cassar-FRC) W82-00945

#### LOW TURBIDITY WATER FROM FAST PROCESSES,

Burlington Water Dept., VT.

T. Atherton, and J. Goss.

Water/Engineering and Management, Vol 128, No 7, p 40-43, July, 1981. 3 Fig, 4 Tab.

Descriptors: \*Turbidity, \*Filtration, \*Clarification, \*Water treatment, \*Burlington, Vermont, Pilot plants, Sand, Filter media, Flocculation, Water quality, Super-Pulsator clarifier.

The water treatment plant for the City of Burlington, Vermont, used microstraining followed by low-head automatic backwash filtration to treat low turbidity (3-15 NTU) Lake Champlain water. The flocculation and sedimentation steps were not considered necessary to meet the drinking water standards of 5 NTU in force in 1959. When turbidity maximum standards were reduced to 1 NTU in 1977, the plant was unable to meet the requirements on some occasions. A search for process modifications eliminated in-line filtration, direct filtration, and a new plant in favor of the Super-Pulsator process, which combines flocculation and clarification. A sludge blanket is formed and raw water with added chemicals is gently pulsed upward through the blanket using a vacuum process. Flocculation occurs within the sludge blanket, part of which is skimmed off the top with each pulsing cycle. Eighteen pilot filter tests on 5 media (sand at different depths and particle sizes and sand-coal) gave information on effluent turbidity, terminal headloss, and run length. Run No. 12, using single sand media, 30 inches deep, effective size 0.65-0.75 mm, at a loading of 4.0 gpm per sq ft produced a 0.21 NTU effluent from a 0.51 NTU influent with terminal headloss of 51 inches and run length of 7.2 hours. Color and Na were unaffected, and Fe was reduced by 50%. The upgraded facilities, scheduled for start of construction in fall 1981, will process 9 mgd more than the current capacity of 10 mgd. (Cassar-FRC) W82-00946

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precursor removal, degree of trihalomethanes removal, other byproducts formed, degree of disinfection, and cost estimates for 20, 50, and 80% removal. According to EPA regulations, trihalomethanes, primarily formed by chlorination of humic materials in raw water, must not exceed 0.10 mg per liter in drinking water. Of the three unit processes—oxidation, aeration, and adsorption—each has advantages and disadvantages. Granular activated carbon, when fresh, is most effective in removing precursors, but this excellent performance is not long-lasting. Clarification, source control, oxidation, adsorption, biological degradation, and pH lowering also significantly lower precursor concentrations. The advantages and disadvantages of alternative disinfectants are discussed. Ozonation is very effective but has no residual action within the distribution system. Chloramines are easy to use and produce residual disinfection but are suspected of being toxic. Chlorine dioxide is very desirable as a disinfectant, but residuals in drinking water may exceed the 0.5 mg per liter limit. Four examples of treatment systems using chlorine as a disinfectant are discussed in detail to illustrate the evaluation process. (Cassar-FRC) W82-00953

**FERRIC CHLORIDE TAKES OVER,**  
Stell Environmental Group, Inc., Lansing, MI.  
K. J. Guter, J. L. Mills, and P. G. Eberz.  
Water/Engineering and Management, Vol 128, No  
7, p 34-39, July, 1981. 1 Fig, 2 Tab.

Descriptors: \*Ferric chloride, \*Turbidity, \*Coagulation, \*Water treatment, Sludge excess, Clarification, East Lansing, \*Michigan, Water treatment facilities.

Sludge buildup and turbidity problems in the water produced at the East Lansing-Meridian Township (Michigan) Water Treatment Plant were solved by replacing the ineffective alum coagulation system with ferric chloride at a concentration of 1.2 mg per liter Fe plus sludge recirculation. The liquid alum storage and feed system required only minor changes to accommodate the change in chemicals. Hydrants are used to monitor the effectiveness of the process changes by noting the time required for turbidity to clear after opening the test hydrant. (Cassar-FRC) W82-00954

#### ECONOMIC ANALYSIS OF GRANULAR-BED FILTRATION,

Syracuse Univ., NY. Dept. of Civil Engineering.  
R. D. Letterman.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 279-291, April, 1980. 5 Fig, 13 Ref.

Descriptors: \*Filtration, \*Economic justification, Economic aspects, Filters, Design criteria, \*Water treatment, Cost analysis, Costs.

Factors and limitations that determine whether or not a particular alternative will be cost effective for granular-bed filtration are presented. Equations are reviewed which are used to illustrate the effect of filter design and operating variables on the total annual cost of filtration, which is taken to be the sum of the annualized capital cost of the filter and the annual cost of operation. In order to compare the economic benefit of various alternatives, such as dual- and mixed-media beds, the analysis must include the effect of each on capital and operating costs. Whether the effluent quality is acceptable in both cases is determined by both the absolute and the relative magnitudes of the filter run lengths. High rate filtration appears to be economically justifiable for all practical filtration rates when the filter loading is within conventional limits. When direct filtration is used and higher solids loading rates occur, shorter run lengths, higher backwash frequency, and resulting higher operating costs may set an economic limit on the filtration rate that is near the range of current practice. Declining-rate filtration appears to have inherent characteristics that make it generally more economical than the constant-rate approach. Using the same design average filtration rate, the lower filtration rate at

the end of the run in the declining-rate filter results in a greater water production per filter run. Combined with what is essentially the elimination of downtime per backwash, this effectively reduces both capital and operating costs. (Baker-FRC) W82-00975

#### DISTRIBUTION SYSTEM LIABILITY, Waukesha Water Utility, WI.

J. H. Kuranz.  
Water and Sewage Works, Vol 127, No 7, p 40-41, 52, July, 1980. 1 Ref.

Descriptors: \*Legal aspects, \*Municipal water, Water quality, \*Utilities, Water distribution, Water conveyance, \*Metropolitan water management, Public health, Leakage, Liability, Negligence, Remedies, Regulations.

Both publicly owned and investor owned water utilities must face the question of the extent of their liabilities. There do not appear to be any definitive legal answers to this question at the present time. Although water utilities are not generally considered as insurers of the purity of the water furnished for public consumption, they are required to use reasonable care and diligence in providing pure and wholesome water and may be liable for resulting injuries if they do not. Water utilities have a duty and an obligation to provide quality water and service. They should protect their interests by carrying good insurance coverage and by conducting programs to ensure proper construction and maintenance of the distribution system. When water mains or laterals fail, the utility will be in a better position to defend itself if it can prove that adequate maintenance was performed and that the response to the failure was prompt. Various measures can be taken to strengthen the utility's position with respect to injury or property damage resulting from fire, thawing frozen laterals, overflowing storage tanks, and shutting off a water supply. Open excavations, blasting, and other activities related to the construction and repair of distribution system facilities place the utility and/or its contractor in a particularly vulnerable position. Benefits of litigation may include reduction of the number of claims as a result of placing the burden of proof upon the complainant, serving public notice that the utility will fight claims against it, and enhancing the public image and internal relations of the utility when negligence cannot be proved. (Carroll-FRC)

W82-01028

#### HOME WATER SOFTENERS, WATER SOFTNESS AND POSSIBLE HEALTH IMPLICATIONS, Illinois Univ. at the Medical Center, Chicago. School of Public Health.

G. R. Brennimann, W. H. Kojola, and A. H. Wolff.  
Journal of Environmental Health, Vol 43, No 1, p  
19-21, July/August, 1980. 2 Tab, 17 Ref.

Descriptors: \*Water softening, \*Human diseases, Cardiovascular disease, Water treatment, Sodium, Magnesium, Calcium, Minerals, Chemical composition, Chemical analysis, Water analysis, Water quality, \*Home water softeners.

This study investigates the degree to which home water softeners alter the concentrations of sodium, calcium and magnesium in drinking water and the relationship of these findings to cardiovascular disease. Water samples (615) were collected in West Dundee and McHenry, Illinois, from households which had ion exchange home water softeners. Identical studies were conducted on samples from 596 households without home water softeners. Home water softeners increased mean sodium concentrations 3.4 to 5 fold and reduced calcium and magnesium concentrations between 1.6 and 1.8 fold among the households sampled in West Dundee and McHenry. If the homeowner does not recharge the softener with salt or replace wornout resins, the efficiency of the softener in removing calcium, magnesium, and other divalent metallic cations is greatly reduced. Over 40% of the tap water from homes with softeners from either West Dundee or McHenry had mean sodium concentrations of 128.9 mg/liter or greater, and mean cal-

cium and magnesium concentrations of 2.6 mg/liter or less. It is suggested that a study of the relationship between home water softener use and cardiovascular disease be made. (Baker-FRC) W82-01045

#### DESIGN AND CONSTRUCTION OF THE DANVERS, MASSACHUSETTS WATER PROCESSING PLANT,

Jordan (Edward C.) Co., Inc., Portland, ME.  
S. Medlar.

Journal of the Institution of Water Engineers and Scientists, Vol 34, No 2, p 175-179, March, 1980. 5 Ref.

Descriptors: \*Design criteria, \*Construction materials, Odor control, \*Water supply, Color removal, Turbidity, Reservoir, Water treatment, Filtration, Adsorption, Cost effectiveness, Water quality, Chloroform, Mixing, Flocculation, Chemical coagulation, Chlorine, Lime, \*Water treatment facilities, \*Danvers, Massachusetts.

The design and construction of a water treatment plant in Danvers, Massachusetts is described. The water had high color, odor, iron, turbidity, and sediment, causing many consumer complaints, prior to treatment. The treatment process used was two-stage flash mixing, tapered flocculation, sedimentation, sand filtration, and granular activated carbon adsorption. Construction of the plant began in 1974 and was completed in 1977 at a cost of 4,400,000 dollars. The water supply was palatable for the first time in 100 years, as a result of the treatment plant. (Titus-FRC) W82-01088

#### ASBESTOS CEMENT PIPE AND CANCER IN CONNECTICUT 1955-1974,

Yale Univ., New Haven, CT.

For primary bibliographic entry see Field 5C.

W82-01094

## 5G. Water Quality Control

#### POTENTIAL MANAGEMENT OF FLORIDA RED TIDE THROUGH SELECTIVE PHOTODYNAMIC ACTION,

University of South Florida, Tampa. Dept. of Chemistry.

J. Barltrop, B. B. Martin, and D. F. Martin.  
Journal of Environmental Science and Health, Part A, Vol 15, No 2, p 163-171, 1980. 1 Fig, 1 Tab, 10 Ref.

Descriptors: \*Red tide, \*Water quality management, Dinoflagellates, Eutrophication, Chemical reactions, Photodynamic action, Hematoporphyrin, Porphyrin.

The effectiveness of the photodynamic action of hematoporphyrin was tested using the unarmored dinoflagellate, *Gymnodinium breve*. Four systems were compared: light control and dark control with the organisms in light or dark, respectively, for 24 hr versus dark and light test in which the organisms plus .00008M porphyrin are left in dark and light, respectively, for 24 hr. Essentially total destruction was noted for the last system (light test), while no statistically significant differences were noted among the other three systems. The effect of the concentration of porphyrin was tested in preliminary experiments. The percentage of red tide survival was not a linear function of porphyrin concentration. The porphyrin probably is not effective at 0.001 of the totally destructive concentration under the conditions of this experiment. However, 0.01 of the totally lethal concentration destroyed about 25% of the cells. These findings indicate the potential application of photodynamic action in the management of red tide blooms. (Baker-FRC) W82-00515

#### THE DISTRIBUTION OF THE COSTS OF FEDERAL WATER POLLUTION CONTROL POLICY,

Resources for the Future, Washington, DC.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

For primary bibliographic entry see Field 6B.  
W82-00537

#### A PROCEDURE USING MODELING AND ERROR ANALYSIS FOR THE PREDICTION OF LAKE PHOSPHORUS CONCENTRATION FROM LAND USE INFORMATION, Michigan State Univ., East Lansing. Dept. of Resource Development.

K. H. Reckhow, and J. T. Simpson.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1439-1448, September, 1980. 2 Fig, 6 Tab, 17 Ref.

Descriptors: \*Model studies, \*Water quality management, \*Lakes, \*Phosphorus, \*Land use, Trophic level, Eutrophication, Mesotrophy, Oligotrophy, Mathematical studies, Watershed management, Error analysis, Prediction.

Recent studies on empirical lake modeling and error analysis have provided valuable methods for evaluating limnologic trophic quality. A technique is presented which utilizes previous models and land use data to predict lake phosphorus levels to aid in watershed management. The phosphorus flux from major types of land use is estimated along with the trophic state of the lake from the predicted phosphorus concentration. To supplement the prediction of phosphorus levels, a nonparametric error analysis is incorporated into the model. Uncertainty levels show the value of the model data generated. The procedure is applicable to most north temperate lakes, and an example of its use on Higgins Lake, Michigan is given. (Geiger-FRC)  
W82-00546

#### DETOXIFICATION OF RESIDUAL QUATERNARIES,

Chemed Corp., Cincinnati, OH. (Assignee).

J. T. Jacob.

U.S. Patent No 4,204,954, 3 p, 3 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1362, May 27, 1980.

Descriptors: \*Patents, \*Water treatment, \*Industrial water, \*Biocontrol, Chemical reactions, Neutralization, Toxicity, Water quality control, \*Detoxification, Biocides, Quaternaries.

Several quaternaries are being used at the present time as biocides for the control of microbiological growth in aqueous systems. The residual quaternaries when discharged into waste streams will interfere in the biological treatment processes by inhibiting the growth of biomass. It has now been discovered that the toxic effect of the residual quaternary compounds can be removed by treating the aqueous solutions with anionic substances to neutralize the activity of the quaternaries by forming stable complexes and thus render them inactive towards aquatic life. (Sinha-OEIS)  
W82-00562

#### TEMPORAL AND SPATIAL SCALES IN PHYTOPLANKTON ECOLOGY, MECHANISMS, METHODS, MODELS AND MANAGEMENT, McMaster Univ., Hamilton (Ontario). Dept. of Biology.

G. F. Harris.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 877-900, May, 1980. 2 Fig, 339 Ref.

Descriptors: \*Literature reviews, \*Model studies, \*Phytoplankton, Fluctuations, Ecology, Nutrients, Water quality management, Water quality control, Plankton, Lakes, Eutrophication, Phosphorus, Aquatic populations, Biomass, Aquatic productivity, Marine environment, Reviews, Freshwater environment.

The temporal and spatial scales of variability in marine and freshwater planktonic environments and the algal responses to them are reviewed. Problems exist with interpreting the results of nutrient model studies under nonsteady conditions. Evidence for the existence and importance of small scale, high frequency and large scale, low frequen-

cy variation in the planktonic environment is presented. Insufficient knowledge of planktonic processes may hinder the management of water quality. A new model of community structure and processes in variable environments is proposed which corrects for the algal scales of perturbation and response and permits certain predictions to be made. When the new paradigm is used, certain problems and controversies in the literature may be rectified and an enhanced ability to manage planktonic systems should result. (Geiger-FRC)  
W82-00594

#### SYSTEM FOR OIL AND WATER SEPARATION,

For primary bibliographic entry see Field 5D.  
W82-00611

#### THE NONFUEL MINERALS INDUSTRY: REGULATORY IMPACTS,

Mitre Corp., McLean, VA. METREK Div.

For primary bibliographic entry see Field 5B.  
W82-00612

#### GROUNDWATER STRATEGIES,

J. Josephson.

Environmental Science and Technology, Vol 14, No 9, p 1030-1035, September, 1980. 4 Fig.

Descriptors: \*Groundwater, \*Pollution control, Groundwater management, Reviews, Decision making, Regulations, Administrative regulations, \*Legal aspects.

Efforts underway by the Environmental Protection Agency and the United States Geological Survey to control and protect groundwater against pollution are reviewed. The EPA is conducting a three phase program. Phase I called for gathering information on water use, contamination, federal/state laws, programs, and the groundwater protection state of the art. Phase II involved workshops comprising representatives of government, business/industry, and professional and environmental advocacy groups. Phase III will be the strategy-determination phase. A clear statement of problems and issues being addressed, a national program with fully defined federal and state roles, a comprehensive EPA policy to apply to all programs concerned with groundwater, tighter relationships among cognizant federal, state and local government bodies, and a short-term action plan will all be a part of the final strategy. One topic of major interest has been the contamination plume which normally follows the direction of groundwater flow, but has been known in certain cases to deviate. Containment of these plumes comprises three principal concepts: complete horizontal and vertical blockage of plume migration, partial blockage wherein the migration is reduced, and removal of the plume through excavation or pumping out. Types of installations are briefly considered, and some attention is directed toward remedial measures. (Baker-FRC)  
W82-00620

#### PRELIMINARY POLLUTANT LIMIT VALUES FOR HUMAN HEALTH EFFECTS,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.

J. C. Dacre, D. H. Rosenblatt, and D. R. Cogley. Environmental Science and Technology, Vol 14, No 7, p 778-780, 782-784, July, 1980. 1 Fig, 3 Tab, 14 Ref.

Descriptors: \*Water pollution control, \*Human diseases, Regulations, Administrative regulations, Standards, \*Water quality standards, Specifications.

A preliminary pollutant limit value (PPLV) concept has been developed to predict probable environmental limits for pollutants. The PPLV is a temporary, nonregulatory value based on information currently available in the literature and that relates primarily to human health effects. PPLVs are determined in six steps: pollutants and pathways of exposure are identified; an acceptable daily dose of toxicant and partition coefficients are

determined; relevant data are gathered; single pathway PPLVs are calculated for all pathways possible; critical pathways for each pollutant are selected, and the PPLV is derived by normalization of the single-pathway PPLV. The whole approach must be understood in a conceptual framework within which to provide environmental decisions. It is totally possible for two environmental engineers to obtain different results from the analysis of an identical situation. These differences may be the result of valid differences in judgement. The present treatment is only a start for critical examinations of other areas such as air pollution derived from sources in soil and water, and effects on aquatic organisms. (Baker-FRC)  
W82-00628

#### THE DESIGN AND INTERPRETATION OF MARINE POLLUTION SURVEYS,

Clyde River Purification Board (Scotland).

For primary bibliographic entry see Field 6E.  
W82-00700

#### GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN,

International Joint Commission—United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.

For primary bibliographic entry see Field 6E.  
W82-00701

#### PHOSPHORUS MANAGEMENT FOR THE GREAT LAKES: FINAL REPORT OF THE PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE,

International Joint Commission—United States and Canada, Windsor (Ontario).

For primary bibliographic entry see Field 6E.  
W82-00702

#### HEALTH IMPLICATIONS OF NON-NTA DETERGENT BUILDERS,

International Joint Commission—United States and Canada, Windsor (Ontario).

Report from the Task Force on the Health Effects of Non-NTA Detergent Builders. October, 1980. 80 p. 6 Tab, 100 Ref, 4 Append.

Descriptors: \*Lakes, \*Water quality, \*Phosphorus removal, \*Detergents, \*Carbonates, Soaps, Phosphates, Phosphorus compounds, Wastewater treatment, Algal growth, Wastewater pollution, Algal blooms, Wastewater analysis, Data collection, \*Great Lakes, International waters.

Under the 1972 Great Lakes Water Quality Agreement between Canada and the United States, measures were taken to reduce the input of phosphorus to the lakes from municipal sewage; phosphate contained in household detergents had been identified as a major contributors. Restrictions on the use of phosphate in detergents have led to an increase in the use of alternative detergent builders. The task force to study non-nitritriacetic acid detergent builders came to the following health effects conclusions related to these builders: (1) Carbonates, which occur naturally in water, have a long history of use as food additives, are classified as Generally Recognized as Safe (GRAS), and pose no human health hazard through their contribution of carbonate to drinking water. (2) Carboxymethylxysuccinate (CMOS), which has been studied by Lever Brothers, is reported essentially non-toxic in those studies. (3) Carboxymethyltartrate (CMT) has been toxicologically studied by the Monsanto Company; however, the lack of primary data precludes a full assessment of its potential prolonged health effects. Based on its chemical structure and properties, CMT is not expected to pose undue health hazards. (4) Citrates ingested in drinking water have not revealed any health hazard, nor have mutagenic or teratogenic effects been reported. (5) Phosphates, soluble silicates, and Type A Zeolite are also considered to be safe to human health. (Garrison-Omniplan)  
W82-00703

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

#### ECOLOGICAL EFFECTS OF NON-PHOSPHATE DETERGENT BUILDERS: FINAL REPORT ON ORGANIC BUILDERS OTHER THAN NTA,

International Joint Commission—United States and Canada, Windsor (Ontario).

Report from Task Force on Ecological Effects of Non-Phosphate Detergent Builders, July, 1980. 71 p. 7 Tab, 89 Ref, 1 Append.

Descriptors: \*Lakes, \*Water quality, \*Phosphorus removal, \*Detergents, \*Phosphates, \*Wastewater treatment, Soaps, Phosphorus compounds, Wastewater pollution, Algal growth, Wastewater analysis, Algal blooms, Data collection.

The Task Force on Ecological Effects of Non-Phosphate Detergent Builders was created because restrictions on detergent phosphates have been used increasingly with the result that alternate materials used by detergent manufacturers are released to the environment. The first report in this series, published in 1978, deals with the organic builder NTA (nitrilotriacetic acid). The three builders studied in this report are citrates, carboxymethyloxysuccinate (CMOS), and carboxymethyltartrate (CMT). Citrate is a natural product which is readily biodegradable by many organisms under aerobic and anaerobic wastewater treatment conditions. The Task Force believes that its use as a detergent builder will not be detrimental to the environment. However, its ability to stimulate algal growth by chelating heavy metals, its interference with the chemical precipitation of phosphate, and its removal during physiochemical treatment need to be studied further. CMOS, which does not occur in nature, is not likely to be detrimental to the environment, but investigations should be undertaken concerning (1) the effect of CMOS on dosages of chemicals used to precipitate phosphate; (2) the removal of CMOS during physiochemical treatment of wastewater; (3) the ability of CMOS to stimulate algal growth; and (4) the degradation of metal chelates of CMOS. CMT is not endorsed as a builder at this time. (Garrison-Omniplan) W82-00704

#### REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,

International Joint Commission—United States and Canada, Windsor (Ontario).

November, 1980. 127 p. 6 Fig, 17 Tab, 306 Ref.

Descriptors: \*Lakes, \*Ecosystems, \*Hazardous materials, \*Aquatic populations, \*Water quality, Toxicity, Viruses, Enteroviruses, Lead, Coliforms, Bacteria, Nutrient removal, \*Great Lakes.

The 1972 Great Lakes Water Quality Agreement was expanded in 1978 with its emphasis on ecosystem quality rather than the narrower focus of water quality. The Aquatic Ecosystem Objectives Committee of the Science Advisory Board was charged with developing objectives, defined as the criteria for describing a desired state of an ecosystem, a concentration of a substance, or a description of a condition that is considered protective of the most sensitive use. Objectives have been chosen as minimum goals by the governments of Canada and the U.S. as a part of the 1978 Agreement. The Committee's recommendations include the following: (1) pentachlorophenol in water should not exceed a concentration of 0.4 micrograms per liter; (2) 2,3,7,8-tetrachlorodibenzoparadioxin (TCDD) should be absent from the entire ecosystem; (3) waters used for body contact recreational activities should be substantially free from bacteria, fungi or viruses that cause enteric disorders and infections; (4) fecal coliform bacteria should not exceed a logarithmic mean of 200 fecal coliforms per 100 mL of sample; and (5) the concentration of total lead in an unfiltered water sample should not exceed 2 micrograms per litre in Lake Superior, 3 in Lake Huron, 4 in Lakes Erie and Michigan, and 5 in Lake Ontario. Additional recommendations are made regarding previous proposals concerning residual chlorine, silver, cyanide, temperature, and nutrients. Specific recommendations on nutrient objectives include limits of 5 micrograms per liter of total phosphorus concen-

trations in Lake Superior, Lake Huron, Georgian Bay, and the North Channel. (Garrison-Omniplan) W82-00705

#### WATER MOVEMENT FOR WATER QUALITY IN CATFISH PRODUCTION,

Alabama Agricultural Experiment Station, Auburn.

C. D. Busch, and C. A. Flood, Jr. Transactions of the ASAEE, Vol 23, No 4, p 1040-1042, July/August, 1980. 1 Tab, 13 Ref.

Descriptors: \*Water quality control, \*Water circulation, \*Fish populations, Aeration, \*Fish farming, Oxidation, \*Catfish, fish, Dissolved oxygen, Oxygen.

There are two categories of approaches to providing adequate dissolved oxygen levels through water movement for fish production ponds. The first is replacement, which involves introducing freshwater from an outside source to the fish production location in exchange for some or all of the existing water. The second is aeration, which involves using some mechanical treatment method to renew or maintain the dissolved oxygen level necessary for fish production. The use of mechanical means to maintain or improve water quality, either by furnishing partial water replacement or by using aerators, is of limited value when compared to photosynthetic oxygen supply. The aerators, is of limited value when compared to photosynthetic oxygen supply. The efficiency of aerators decreases as saturation is approached, and the aerator will remove oxygen from super-saturated water. The topographical components necessary for continual water exchange through gravity flow from an ample supply of good quality water are seldom encountered. Using paddle wheels or other means to move the water for the purpose of mixing may complement the naturally-created dissolved oxygen supply, preventing the buildup of high oxidation demands and near anaerobic conditions at the lower levels of ponds. (Carroll-FRC) W82-00866

#### EVALUATION OF STRIPMINE SEDIMENT DETENTION BASINS IN KENTUCKY,

Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.

A. D. Ward, and C. T. Haan. Transactions of the ASAEE, Vol 23, No 4, p 854-858, 865, July/August, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: \*Sedimentation basins, \*Strip mine wastes, \*Monitoring, \*Kentucky, Sediments, Coal mining, Industrial wastes, Detention reservoirs, Basins, Sediment control, Sedimentation ponds, \*Water pollution control.

The Surface Mine Reclamation Act of 1977 requires surface coal mining and reclamation operations to use sedimentation ponds to help control the discharge of high sediment concentrations to receiving waters. Although such ponds have been used for several decades, very little data on their performance available, and design methods have generally proved to be inadequate. This monitoring project was designed to evaluate the effectiveness of sediment basins in controlling runoff and downstream sediment loading at two stripmine coal operations in eastern Kentucky and to develop design criteria for predicting sediment detention basin performance. Establishing a monitoring program at a sedimentation pond for strip mining operations requires the purchase and installation of a sampling unit, a stilling tower, tower instrumentation, dock, and relay cables. The research team for two or three ponds should be composed of an engineer and two technicians. The ponds monitored, which were small and inadequate to meet proposed Federal regulations, at times exhibited high trap efficiencies, but had low overall efficiencies. Simulation studies with the Deposits Model indicated that both ponds exhibit efficiencies of less than 20 percent for a 10-year, 24-hour storm. It is recommended that design plans include provision of a permanent pond capable of storing all the runoff from a 2-year, 2-hour event, installation of a mechanical dewatering device to dewater part of this stored sediment, and installation of a mechani-

cal physical/chemical treatment system to be used during larger events. Such a design should provide pond trap efficiency approaching 100 percent while requiring chemical treatment of runoff only a few times each year. (Carroll-FRC) W82-00893

#### REVIVING ACIDIFIED LAKES,

Uppsala Univ. (Sweden). Dept. of Limnology.

For primary bibliographic entry see Field 2H.

W82-00933

#### DRYLAND MANAGEMENT FOR SALINITY CONTROL,

For primary bibliographic entry see Field 2G.

SALINE SEEP DEVELOPMENT AND CONTROL IN THE NORTH AMERICAN GREAT PLAINS - HYDROGEOLOGICAL ASPECTS, Montana Bureau of Mines and Geology, Butte. For primary bibliographic entry see Field 5B.

W82-01022

#### IMPACT OF WATER RESOURCE DEVELOPMENT ON SALINIZATION OF SEMI-ARID LANDS,

California Univ., Davis. School of Civil Engineering.

For primary bibliographic entry see Field 5B.

W82-01024

#### EFFECTS OF NITRAPYRIN ON NITRATE MOVEMENT IN SOIL COLUMNS,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.

L. B. Owens.

Journal of Environmental Quality, Vol 10, No 3, p 308-310, July-September, 1981. 2 Fig, 2 Tab, 12 Ref.

Descriptors: \*Leaching, \*Soil columns, \*Nitrates, Nitrification, Inhibitors, Ureas, Groundwater pollution, Water pollution prevention, Path of pollutants, \*Nitrapyrin, \*Water pollution control.

The increasing cost of fertilizers and growing concern with nonpoint source water pollution has led to increased interest in more efficient use of fertilizer nitrogen. Nitrapyrin (2-chloro-6-(trichloromethyl) pyridine), which is the active ingredient of N-Serve, has specific toxicity to *Nitrosomonas* spp., which is the main microorganism responsible for the nitrification of ammonium to more leachable nitrogen forms in soil. This study investigated the possible benefits of a nitrification inhibitor in terms of retardation or reduction in the amounts of nitrate leaching through the soil profile into the groundwater. Nitrapyrin treated urea of an untreated area was incorporated into the top 10 centimeters of prewetted sandy loam soil cores. The soil columns were leached periodically with distilled water. After 91 days, only 1 percent of the applied nitrogen had leached from the nitrapyrin-treated cores, while 9.7 percent had leached from the untreated cores. After 144 days, 53.0 percent of the applied nitrogen had leached from the untreated cores, while only 41.9 percent had leached from the nitrapyrin-treated cores. Examination of the cores after 144 days showed that the mineral nitrogen concentration was greater at all depths in the soil treated with nitrapyrin than in the untreated soil and that the total mineral nitrogen remaining in the untreated soil was only 70 percent of that remaining in the nitrapyrin treated soil column. These short-term results indicate that nitrification inhibitors such as nitrapyrin may have an important role to play in controlling nonpoint source pollution problems by reducing both the rate of entry and the total quantity of nitrate-nitrogen leached into subsurface waters. (Carroll-FRC) W82-01048

#### WATER CHEMISTRY CHANGES DURING ARTIFICIAL AERATION OF SPRUCE KNOB LAKE, WEST VIRGINIA,

## WATER RESOURCES PLANNING—Field 6

### Techniques Of Planning—Group 6A

West Virginia Univ., Morgantown. Dept. of Biology.  
J. W. Labaugh.  
*Hydrobiologia*, Vol 70, No 3, p 201-216, May, 1980. 9 Fig, 6 Tab, 41 Ref.

Descriptors: \*Water quality, \*Aeration, \*Nutrients, Nitrogen, Phosphorus, Lakes, Reservoirs, Chemical properties, \*Spruce Knob Lake, West Virginia, Chlorophyll, Primary productivity, Alkalinity, Chemical reactions.

Artificial aeration in Spruce Knob Lake using a modified full lift aerator increased water temperature below 3.5 meters from 13.6 to 15.6-16.5 °C without causing destratification. No aeration was done in 1973, intermittent compressed air was used from July to September 1974, and continuous mechanical aeration using a propeller and aeration box, from May to September 1975. Below 3.5 meters' depth, total inorganic C, total alkalinity, nitrite, soluble reactive P, and total P were lower during aeration than during the summer of no aeration. There was no significant impact on the P budget of the impoundment. Nitrate levels were higher, 315 mg per cu meter, in 1975 than in previous years, which averaged 109-125 mg per cu meter. In early June 1975 a brief destratification caused by weather conditions increased H<sup>+</sup> concentrations and lowered chlorophyll concentrations. Aeration produced no temperature or water chemistry changes in the epilimnion, chlorophyll, or primary production. (Cassar-FRC)  
W82-01049

GROUNDWATER QUALITY MODELS - STATE OF THE ART,  
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.

M. P. Anderson.  
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN, p 90-96, 3 Fig, 20 Ref.

Descriptors: \*Groundwater pollution, \*Model studies, Hydrologic models, Data collections, Hydrologic data collections, Advection, Mathematical models, Chemical reactions, Field investigations, Model testing, Waste disposal, Public policy, Public participation.

Concern over groundwater pollution has been voiced by scientists, government officials, and the general public, and has brought about a desire for increasing monitoring, techniques to predict the consequences of waste disposal on groundwater, and effective remedial measures to restore polluted groundwater. While monitoring and remedial measures are often expensive to implement, the use of a groundwater model is relatively inexpensive and is an efficient means of characterizing a field setting. However, of the three basic types of models—advection, advection-dispersion, and geochemical—only the advection type is applicable to regulation, planning and management in its present form. Advection models may be useful in instances where the contaminant is not affected by dispersion and chemical reactions, or to estimate the worst possible case for contaminant transport. The applications of advection-dispersion models and geochemical models to groundwater systems are currently in the research stages. Incorporating chemical reactions into both advection and advection-dispersion models is a difficult problem. The theoretical development of contaminant transport models ahead of field knowledge of the processes themselves, and refinement of the models must await input from field studies. In particular, ways of correctly quantifying the dispersion process and the types and rates of chemical reactions that occur in the subsurface must be developed. (Garrison-Omniplan)  
W82-01061

MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS: REFUGE MANUAL,  
RPC, Inc., Austin, TX.  
W. L. Longley, R. Jackson, and B. Snyder.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117508, Price codes: A20 in paper copy, A01 in microfiche. Fish and Wildlife Service Report FWS/OBS-81/22, September, 1981. 466 p, 11 Fig, 192 Ref, 2 Append. 14-16-0008-2152.

Descriptors: \*Ecosystems, \*Coastal marshes, \*Wildlife refuges, \*Fuel, \*Exploration, Environmental effects, Salt marshes, Levees, Spoil banks, \*Oil industry, Oil spills, Protection, Wildlife management, Texas, Louisiana.

The impacts of all aspects of oil and gas development on coastal ecological systems were investigated and the safeguards used in protecting refuge lands were assessed. Five wildlife refuges along the Texas and Louisiana coasts (Aransas, Brazoria, San Bernard, Delta, and Sabine National Wildlife Refuges) were selected for intensive study. They were characterized by a diversity of ecosystems; oil exploration, extraction and transport; and oil and gas development periods of various durations. Six ecosystems were identified: coastal uplands, salt marsh, brackish marsh, fresh marsh, delta marsh, and levees and spoil banks. For each ecosystem systematic impact and methods assessments were determined for the successive phases of development; seismic preexploration, access to site, well-site preparation and operation, installation and maintenance of lines, placement and operation of production facilities, spills and cleanup, and site shutdown and restoration. Successful and proposed stipulations are given for each of these categories. A wide variety of protective measures are in use, developed from the observations and experimentation of refuge managers, often on the basis of site-specific conditions. (Brambleby-SRC)  
W82-01081

## 6. WATER RESOURCES PLANNING

### 6A. Techniques Of Planning

RISK AND THE DEMAND FOR SUPPLEMENTAL IRRIGATION: A CASE STUDY IN THE CORN BELT,  
Kentucky Univ., Lexington. Dept. of Agricultural Economics.

J. Apland, B. A. McCarl, and W. L. Miller.  
*American Journal of Agricultural Economics*, Vol 62, No 1, p 142-145, February, 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: \*Supplemental irrigation, \*Corn belt, \*Economic aspects, Mathematical models, Agriculture, Risks, Corn, \*Crop production, Irrigation, Planning.

There has been a rapid increase in irrigated acreage in the Corn Belt in recent years as a result of the considerable sensitivity of corn plant growth and associated grain yield to moisture stress during pollination. Increased irrigation has resulted in renewed interest in questions relating to water resource management and to the economic feasibility of supplemental irrigation. Most studies of the economic feasibility of irrigation have focused on the relationship of increases in crop revenues to the costs of irrigation. However, no thorough analysis has been made of the impact of risk aversion on the demand by farm firms for supplemental irrigation. A mathematical programming model of a Corn Belt grain farm was used to evaluate the implications of risk aversion for the derived demand for supplemental irrigation of corn. The model, which was a slightly altered variant of the MOTAD model developed by Hazell, considered riskiness of alternative production activities. Expected profit less a cost of bearing risk was maximized by the model, subject to the technology specified and an endowment of fixed resources. The production model used in the study was an adaptation of a research and extension model of farm production in which the time characteristics of farming were critical. The results of the analysis indicate that the influence of a manager's risk posture has a marked impact on the firm's demand for irrigation. Rational farm managers who are averse to risk may use

irrigation technologies even when irrigation costs are high and corn prices are low. When risk aversion is evident, the demand for irrigation as a factor of production becomes increasingly inelastic. The implications of risk aversion should be considered in descriptive analyses of the adoption of irrigation. In addition, the question of risk should be addressed in assessments of aggregate demand for irrigation. (Carroll-FRC)  
W82-00522

INTERPRETING DYNAMICS OF AQUATIC RESOURCES: A PERSPECTIVE FOR RESOURCE MANAGERS,  
Great Smoky Mountains National Park, Gatlinburg, TN.  
G. L. Larson.  
*Environmental Management*, Vol 4, No 2, p 105-110, March, 1980. 9 Fig, 4 Ref.

Descriptors: \*Parks, \*Water resources management, \*Ecological effects, Planning, Aquatic environment, Lakes, \*National parks, Trophic level, Environmental effects, Productivity, Biomass, Fish, Aquatic plants, Insects.

The Leopold Report (1963) recommended that the biological associations of national parks be managed in the condition existing at the time of the first visits by Europeans. Management of natural processes on the ecosystem level is suggested in this report. It is necessary to consider the effects of making changes in natural resources and to differentiate between natural and unnatural changes. This paper presents, for the resource manager, some graphical approaches to viewing the complex interactions in aquatic systems. Some of the relationships depicted are consumer biomass vs. prey biomass at high, medium, and low productivity; consumer biomass vs. growth and production of the consumer at high and low levels of productivity; and insect biomass vs. fish biomass at high and low yield and at high and low plant biomass. (Cassar-FRC)  
W82-00539

TOWARDS A PREDICTIVE MODEL FOR THE ECONOMIC REGULATION OF COMMERCIAL FISHES,  
British Columbia Univ., Vancouver. Dept. of Mathematics.  
C. W. Clark.  
*Canadian Journal of Fisheries and Aquatic Sciences*, Vol 37, No 7, p 1111-1129, July, 1980. 3 Fig, 34 Ref.

Descriptors: \*Commercial fishing, \*Fisheries, \*Regulations, Fishing, \*Model studies, Economic impact, Prediction, Taxes, Licensing.

A model for predicting the consequences of various methods of regulating commercial fisheries is developed. Alternatives considered were total catch quotas, vessel licenses, taxes on catch, allocated vessel quotas, and regulation of fishing effort. The model predicted that taxes and allocated transferable catch quotas are theoretically equivalent to each other in terms of economic efficiency and both can optimize exploitation of the common-property fishery. However, quotas provide a more direct control over the fish stock. Total catch quotas and closed seasons cause expansion of fleet capacity and shortening of the fishing season. Without additional controls, such as total catch regulation, vessel licensing could intensify fishing effort and shorten the fishing season. (Cassar-FRC)  
W82-00549

LAND TREATMENT OF MUNICIPAL WASTEWATER IN SMALL COMMUNITIES,  
Economics, Statistics, and Cooperatives Service, Washington, DC. Natural Resources Economics Div.  
For primary bibliographic entry see Field 5D.  
W82-00588

## Field 6—WATER RESOURCES PLANNING

### Group 6A—Techniques Of Planning

**MODELING THE TRANSFORMATION OF NITROGEN COMPOUNDS FOR WATER-QUALITY MANAGEMENT IN STREAMS,**  
O. F. Vasil'ev, and E. V. Eremenko.  
Water Resources (English Translation), Vol 7, No 5, p 437-442, September/October, 1980. 12 Refs.  
Translated from *Vodnye Resursy*, No 5, p 110-117, September/October, 1980.

Descriptors: \*Mathematical models, \*Water quality management, \*Nitrogen compounds, Water conservation, Streams, Prediction, Water quality, Biological oxygen demand, Dissolved oxygen, Mathematical equations, Management planning, Planning.

Mathematical models are being used increasingly to make the evaluations of water quality used for water pollution control decisions, but certain improved models are not generally used in models designed to optimize the cost of conservation measures because they are poorly adapted for linking up with optimization models. The model of transformation of nitrogen compounds makes it possible to determine the concentration of standardized substances contained in wastewater and being formed in receiving water bodies as a result of the transformation of nitrogen-containing substances. Solutions to this model, represented in the form of simple linear dependences for the concentrations of nitrogen compounds and characteristic sites of the stream, are presented which are suitable for predicting water quality and convenient for use when solving optimization problems. Linear dependences convenient for solving management problems can be obtained by examining the concentrations of substances at boundary sites of prismatic sections of the investigation channel stream. Equations for accomplishing this describe the effect of the concentration of some substances on the concentration of other, indicating the possibility of managing water quality through regulating the concentration of one substance by changing the discharge of another. The mathematical model of the formation of water quality can then be linked to the optimization model in terms of the magnitudes of wastewater discharges. (Carroll-FRC) W82-00598

**USING ECOLOGICAL KNOWLEDGE FOR DEVELOPMENT PLANNING,**  
East-West Environment and Policy Inst., Honolulu, Hawaii.  
R. A. Carpenter.  
Environmental Management, Vol 4, No 1, p 13-20, January, 1980. 1 Fig, 1 Tab, 18 Refs.

Descriptors: \*Decision making, \*Ecology, \*Developing countries, Planning, Legal aspects, Natural resource development, Research priorities, Water resources development, Cost-benefit analysis, Economic aspects.

A multinational collaborative project has been developing natural systems assessments for developing countries. These nations, now more aware of the effects of resource exploitation, are passing legislation and organizing agencies for environmental protection. This produces channels for transferring ecological knowledge into political and administrative decision making. A satisfactory classification system considers the natural systems (terrestrial—crop, grazing, and forest lands; and aquatic—rivers, lakes, and coastal zones) as a whole and the various developmental sectors such as industry, agriculture, water impoundment, irrigation, domestic water supply and sewage disposal, and fisheries. Benefit-cost analysis is valuable in integrating ecological knowledge into economic development decision making. The list of priorities for ecological research includes the benefits of a healthy landscape, long term uses, results of intensified agriculture and forestry in tropical countries, and the assimilative capacity of water bodies. (Cassar-FRC) W82-00671

**RICHARDS BAY: AN ECOLOGICAL DILEMMA,**  
Department of Environmental Planning and Energy (South Africa).  
N. Viljoen.

Civil Engineer in South Africa, Vol 22, No 4, p 84-90, April, 1980. 4 Fig, 45 Refs.

Descriptors: \*Water resources development, \*Planning, Management planning, Decision making, Administrative decisions, Water demand, \*Harbors, \*Construction, \*Ecological effects, \*Richards Bay, South Africa.

At Richards Bay, South Africa, planning was begun for the construction of a future harbor city of metropolitan size, and it was intended to tie in the planning with that of other projects in the area so as to conserve the natural environment. This preservation was incorporated into the policy making, program designing, and financing of the growing complex. The ecological dilemma and the vastness of the situation were resolved into areas where sufficient expertise and background knowledge already existed to ensure sound policy making, and other areas where the status of appreciation ranged from rational deductions to total ignorance. Specific studies were made of the climate and atmosphere, plant ecology, agriculture of the area, hydrogeophysical considerations, the estuarine and marine environment, freshwater ecosystems, and recreation and conservation. (Baker-FRC) W82-00679

**PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON,**  
Geological Survey, Boise, ID. Water Resources Div.

G. F. Lindholm.

Available from the OFSS, USGS Box 25425, Denver, CO 80225, Price: \$2.75 in paper copy, \$3.50 in microfiche. Geological Survey, Open-File Report 81-689, June 1981. 21 p, 4 Fig, 17 Ref.

Descriptors: \*Aquifer management, \*Project planning, \*Regional analysis, \*Geohydrology, Aquifer characteristics, Drawdown, Groundwater movement, Surface-groundwater relations, Groundwater recharge, Groundwater availability, Irrigation, Water supply, Model studies, Water quality, Geochemistry, \*Idaho, \*Oregon, \*Snake River Plain, Regional Aquifer System Analysis.

The 15,600-square-mile Snake River Plain is largely in southern Idaho and includes one of the Nation's major regional aquifers. A comprehensive investigation of the area's ground-water resources will be made as part of the U.S. Geological Survey's Regional Aquifer-System Analysis (RASA) program. Basaltic and sedimentary rocks in the Snake River Plain yield large quantities of water that are vital to the area's agricultural economy. Basaltic rocks predominate in the eastern Snake River Plain and have especially high water-yielding capabilities. Surface water, largely from the Snake River, is extensively used for irrigation and is a major source of recharge to the ground-water system. Springs issuing from basaltic rocks that form the Snake River Canyon wall near Twin Falls are the major points of ground-water discharge. Increased use of ground water for irrigation is causing concern as to the effect of large-scale withdrawals on spring flow. Ground-water flow models will be used to improve understanding of the hydrologic system, and, if feasible, to aid in evaluating management alternatives. Ground-water quality will be defined and geochemical techniques used to determine the effects of water-rock reactions on water quality. Several reports are planned on different phases of the project, concluding with a summary report. (USGS) W82-00730

**MANAGEMENT PROVOKED CONFLICT IN FISHERIES,**  
Oregon State Univ., Corvallis. Dept. of Anthropology.  
C. L. Smith.

Environmental Management, Vol 4, No 1, p 7-11, January, 1980. 4 Fig, 10 Refs.

Descriptors: \*Fisheries, \*Management, \*Social aspects, Planning, \*Fish management, Safe yield,

**Yield, Economic aspects, Regulations, Resources management.**

The conflicts seen in the management of many U.S. fisheries result from the way in which management concepts are applied. Managing with maximum sustainable yield means managing on the fringe of conflict because attempts to reduce yields cause different groups (public, fisherman, and consumers) to complain. Although management can constrain the ability to catch fish, it has little impact on expectations of greater catches and more profit. Social goals should be incorporated into fishery management and evaluated against management goals. A planning process adapted from the Water Resource Council is: (1) specify relevant objectives, (2) evaluate resource capabilities, (3) formulate alternative plans, (4) analyze differences among alternatives, (5) review and revise, and (6) select plan. Steps 3 and 4 are the points where these public goals need to be considered. (Cassar-FRC) W82-00780

**GAME THEORY ANALYSES APPLIED TO WATER RESOURCE PROBLEMS,**  
Iowa Univ., Iowa City. Inst. of Urban and Regional Research.  
M. Sheehan, and K. C. Kogiku.

Socio-Economic Planning Sciences, Vol 15, No 3, p 109-118, 1981. 1 Fig, 8 Tab, 31 Ref.

Descriptors: \*Water resources development, \*Negotiations, \*Water allocation, Economic aspects, Communication, Remedies.

The theory of cooperative games involving two or more actors is applied to various water resource problems. The practical problem to be considered is how to apportion fairly the reduced costs and increased benefits which result when individuals join together to reap the gains of collective action. Most large resource development projects are collective in nature, and waste treatment projects usually involve at least two parties. Recently, standard-setting government agencies have participated. Scenarios are developed to illustrate the theory of cooperative games and to point out the problems and complexities involved. Recent applications of game theory are described, including optimum development of the Ganges and its tributaries for flood control, hydroelectric generation, and irrigation. Game theory can be used to help negotiators see the benefits of cooperative solutions in many situations of conflict. (Small-FRC) W82-00802

**NUMERICAL SIMULATION OF POTENTIOMETRIC SURFACE CHANGES CAUSED BY A PROPOSED OPEN-PIT ANTHRACITE MINE,**  
Stone and Webster Engineering Corp., Cherry Hill, NJ.

E. S. Bair, and R. R. Fariziek.  
Ground Water, Vol 19, No 2, p 190-200, March/April, 1981. 11 Fig, 20 Ref.

Descriptors: \*Computer models, \*Groundwater movement, \*Mining engineering, Land use, Subsidence, \*Potentiometric level, Permeability coefficient, Baseline studies, Mathematical models, Projections.

Hydrologic and hydrogeologic data were obtained, assessed, and incorporated into a groundwater flow model designed to forecast changes in a groundwater flow system caused by a proposed mining operation. The Trescott, Pinder, and Larson finite-difference flow model was modified and used to simulate potentiometric surface changes caused by the first eight years of development of an open-pit anthracite mine at Wabash Creek, Pennsylvania. The coefficient subroutine was modified to allow the value of hydraulic conductivity to vary with depth. The data input subroutine was changed to allow the number, location, and hydraulic head of constant-head nodes to vary with the time period. Also, the mass balance subroutine was altered to print out the flux into each constant-head node at the end of each time period, thus permitting calculation of changes in the rate of groundwater flow into the mine. Using

## WATER RESOURCES PLANNING—Field 6

### Evaluation Process—Group 6B

site specific values for hydraulic conductivity and other parameters, the simulations predicted that in eight years a cone of depression approximately 20,000 feet long, 8000 feet wide, and 1000 feet deep would form around the proposed mine. The numerical model demonstrated the ability to model the flow system in a complex geological terrain and change the magnitude, location, and type of stress imposed on the flow system. (Small-FRC) W82-00819

**ANSWERS: A MODEL FOR WATERSHED PLANNING,** Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.

D. B. Beasley, L. F. Huggins, and E. J. Monke. Transactions of the ASAE, Vol 23, No 4, p 938-944, July/August, 1980. 9 Fig, 3 Tab, 18 Ref.

Descriptors: \*Watershed management, \*Management planning, \*Computer programs, Simulation analysis, Simulation, Mathematical studies, Mathematical models, Watersheds, Planning, Land use, Water quality management, Water pollution effects, \*Nonpoint pollution sources, Runoff, Overland flow, Inflow.

The ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) program was developed as a planning model to assess the effects of land uses, management schemes, and cultural practices on the quality of water leaving the watershed; to assess pollution problems from nonpoint sources; and to define cost-effective solutions for primarily agricultural watersheds. The overall structure of the ANSWERS program comprises a hydrologic model, a sediment detachment/transport model, and several routing components necessary to describe the movement of water in overland, subsurface, and channel flow phases. A distributed parameter concept is used in the attempt to model the spatially varying processes of runoff, infiltration, subsurface drainage, and erosion. Application of the program to unaged watersheds should result in at least comparative results for various treatment or management strategies. Experience has demonstrated the ability of the program to model observed hydrologic events on agricultural watersheds with good agreement. ANSWERS can become a valuable tool in planning cost-effective measures for controlling non-point source pollution when it is driven with hypothetical storms of known return interval. (Carroll-FRC) W82-00898

**TAMPA BAY WATER GUARDED BY COMPUTER,** Camp, Dresser and McKee, Inc., Clearwater, FL. For primary bibliographic entry see Field 4B. W82-00934

**EFFECTIVENESS OF RIVER MODELS,** Nevada Univ. System, Las Vegas. Desert Research Inst.

R. H. French, and P. A. Krenkel. Water Science and Technology, Vol 13, No 3, p 99-113, 1981. 5 Fig, 1 Tab, 17 Ref.

Descriptors: \*Model studies, \*Water quality, \*Rivers, Sensitivity analysis, Planning, Mathematical models, Willamette River, Calibration, Model testing, Data interpretation.

Modeling of river water quality is a practical tool in water resources planning and water quality management, but only if used correctly. Eight factors affecting the effectiveness of models are discussed. Some processes are not easy to model, e.g., erosion, eutrophication, and toxicity relationships. Dissolved oxygen, temperature, and dissolved solids are relatively easy to model. Indicator bacteria, sediment transport, algal growth, metal transport, nutrient transport, and pesticide transport are intermediate in complexity. General case models are not always applicable to specific rivers. The model should be chosen to fit the river, not vice versa. Concentration on a critical time period may suffice to answer the study question. For example, low dissolved oxygen may only occur during

summer. Calibration and verification are necessary for good results. The two are independent, and different data sets should be used for each. Any drastic change in the river system may require recalibration and verification. Proper sampling and monitoring are important for a statistically reliable data base. The model results must be presented in nontechnical language, understandable by managers and planners. The model should be developed well in advance of actual need, so that calibration, verification, sampling, etc., can be designed and executed in an optimum fashion. The validity of the model's basic assumptions needs periodic re-evaluation. A significant use of models is sensitivity analysis, showing the effect of variation of a given parameter on the output if all other factors are constant. This is illustrated with a study on the Willamette River. (Cassar-FRC) W82-00961

**WATER QUALITY EVALUATION OF REGIONAL WASTEWATER MANAGEMENT,** Toronto Univ. (Ontario). Dept. of Civil Engineering.

For primary bibliographic entry see Field 5D. W82-00977

#### SIMULATION MODELING OF PRIMARY CLARIFIERS,

Paramount Engineering Ltd., Kitchener (Ontario). R. L. Alarie, E. A. McBean, and G. J. Farquhar. Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 293-309, April, 1980. 8 Fig, 4 Tab, 21 Ref.

Descriptors: \*Clarifiers, \*Simulation analysis, \*Model studies, Clarification, Chemical precipitation, \*Wastewater treatment, Filtration, Mathematical studies.

A simulation model is derived for circular primary clarifiers. Predictions from the model are compared with results from existing regression based on models for a case study applied to the Waterloo Water Pollution Control Plant, Ontario, Canada. The simulation model was used to produce general results indicating the relationship between suspended solids removal and the parameters of overflow rate, detention time, and initial suspended solids (SS) concentrations. Two initial SS concentrations were used in conjunction with the settling properties data obtained from the plant. Varying overflow rates and clarifier depths were also used. Effluent SS concentrations increased with increasing overflow rates. The performance of the clarifier deteriorated rather rapidly once an overflow rate of 39,100 liters/day/square meter was exceeded. Percent removal was usually greater at higher initial SS concentrations because of a higher proportion of settleable solids than at lower initial SS concentrations and because of a greater frequency of interparticle contact. Additional depth beyond 3.7 meters produced little improvement in the percentage of SS removal at the above overflow rate. While this may not be true for all types of wastes, it was felt to be accurate for domestic sewage. The simulation model allowed accurate predictions of the performance of the clarifier at various chemical dosages with only minimal laboratory experimentation to determine settling properties. The ability of the model for accurately predicting short-term variations in effluent characteristics may be valuable to a plant operation or to the sanitary engineer studying impact of effluent on a receiving stream. (Baker-FRC) W82-01027

**MATHEMATICAL MODELING TECHNIQUES FOR GROUNDWATER MANAGEMENT,** Prickett (Thomas A.) and Associates, Urbana, IL. For primary bibliographic entry see Field 4B. W82-01062

#### 6B. Evaluation Process

**THE WATERWAY THAT CANNOT BE STOPPED,**

For primary bibliographic entry see Field 6E. W82-00510

**EVALUATION OF THE OLDMAN RIVER BASIN IRRIGATION PROPOSALS: IMPLICATIONS FOR INTERBASIN TRANSFERS,** Department of Agriculture, Lethbridge (Alberta). Irrigation Div.

W. Phillips, M. McMillan, and T. Veeman. Canadian Water Resources Journal, Vol 6, No 2, p 54-61, 1981. 4 Ref.

Descriptors: \*Water resources development, \*Planning, \*Irrigation, River basins, Irrigation efficiency, Economic aspects, \*Oldman River, Interbasin transfer, Water transfer, Alberta, Canada.

The Oldman River Basin Study, Phase II, an economic evaluation, is reviewed. The role and importance of economic evaluations for water resources planning and the implications for interbasin transfers are discussed. Two issues which cast doubt upon the purported economic merits of development alternatives in the Oldman Basin are the improper inclusion of secondary benefits arising from increased regional employment, and the assumed zero opportunity cost of extra capital and labor required when shifting from dryland to irrigated agricultural land use. When these two factors are adjusted for, the benefit-cost ratio is rendered less than one, thus raising some question about the merits of the Oldman irrigation proposals in terms of economic efficiency. It is suggested that any assessment of future water development or diversion proposals should take these two factors into account. (Baker-FRC) W82-00519

**THE DISTRIBUTION OF THE COSTS OF FEDERAL WATER POLLUTION CONTROL POLICY,** Resources for the Future, Washington, DC.

L. P. Giannesi, and H. M. Peskin. Land Economics, Vol 56, No 1, p 85-102, February, 1980. 9 Tab, 14 Ref.

Descriptors: \*Water pollution control, \*Public policy, \*Federal jurisdiction, \*Cost allocation, Economic aspects, Political aspects, Pollution control, Cost analysis, Social aspects, Costs.

In comparing the costs and benefits of a program, it is probably inaccurate to assume that dollar costs provide a reasonable approximation of the true opportunity costs of the program. A first step towards identification of the real opportunity costs and of the distributional consequences of full implementation of the Clean Water Act in its 1972 version involves description of the short-run costs as felt by families because of their tax burdens and initial increases in the costs of goods they consume. The results of investigation of these short-run costs are presented by particular income, racial, and geographic classifications. The costs used in this study assumed perfectly inelastic demands throughout the economy; were incremental in that they represented the costs to be incurred by industry and municipalities to meet the law's objectives over and above pollution control expenditures already made; and were annualized in order to permit presentation of all costs in per annum terms. Analysis of these costs indicates that the costs of industrial and federal government pollution control policies are largely felt outside of the geographical areas in which they are initially incurred; that average per family control cost burden percentages decline with increases in income; that water pollution control policy is less regressive than the clean air policy; and that whites have a greater absolute burden for pollution control, while non-whites generally have a slightly greater proportional burden. These results suggest that federal government subsidies may tend to alleviate the regressive burdens which result from shifting of polluters' costs to consumers and from relatively regressive state and local tax structures. (Carroll-FRC) W82-00537

**SMALL HYDRO INSTALLATIONS SPUR UNIQUE ENGINEERING SOLUTIONS,**

## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

Tudor Engineering Co., Riverton, WY.  
D. C. Willer.  
Power Engineering, Vol 84, No 1, p 62-64, January, 1980. 2 Fig.

Descriptors: \*Hydroelectric plants, \*Capital costs, Powerplants, Economic aspects, Decision making, Design criteria.

Capital costs of small hydropower installations range from \$685 to \$1400 per kW at the 1978 base cost level. The resulting energy costs varies from 13 to 25 mills/kWh. Location of a new power plant is a major engineering consideration. Various configurations must be considered to determine the one best suited to the needs at hand. Box Canyon Dam in California is a typical example of numerous dams, constructed primarily to impound water for irrigation or recreation during a period when it was not feasible economically to install generation capacity. Plans are now underway to build a 4000 kW power plant at that location, which will cost about \$3 million. One interesting innovation here is the placement of the power plant under an extension of the spillway apron, which is economical and offers the least adverse visual and environmental impact. Many small hydro plants under consideration will utilize irrigation impoundments and canal drops. (Baker-FRC)

W82-00538

**THE U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER RESOURCES PROGRAM,**  
Geological Survey, Reston, VA. Water Resources Div.

B. K. Gilbert, and T. J. Buchanan.  
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$4.00 in paper copy, \$3.50 in microfiche. Geological Survey Open-File Report 81-691, 1981. 27 p, 2 Fig, 5 Tab, 4 Ref.

Descriptors: \*Water management, \*Cooperatives, \*Hydrologic data, \*Evaluation, Water supply, Water quality, Water use, Planning, Costs, \*Federal-State cooperation, Geological survey.

The U.S. Geological Survey Federal-State Cooperative Water Resources Program is a partnership between the Geological Survey and State and local agencies for the collection of the hydrologic information needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources. The Cooperative Program has served the Nation for more than 80 years, and in 1981 more than 800 State and local agencies have cooperative programs with the Geological Survey with total funding over \$80 million. The process of project selection in the Cooperative Water Resources Program is a mutual effort in which Geological Survey represents national interests, including the needs of other Federal agencies, and the cooperator represents State and local interests. The result is a balanced program that involves careful evaluation of needs, priorities, and resources. The cost sharing ratio of 50-50 is examined and determined to be the best ratio to effectively assess the Nation's water resources. The Cooperative Program is and has been relevant to the problems of the day. Much of the current technology in ground-water management, ground-water quality, and flood-plain management—to name a few—was developed as part of the Cooperative Program. (USGS)

W82-00735

**WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH.**  
Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation.  
For primary bibliographic entry see Field 6D.  
W82-00736

**EVALUATING IRRIGATION SYSTEMS,**  
B. McLellan.  
World Farming, Vol 23, No 1, p 12-15, January/February, 1981.

Descriptors: \*Irrigation systems, \*Cost-benefit analysis, \*Evaluation, Economic evaluation, Labor, Farm equipment.

The most appropriate irrigation system for a given situation can be chosen by comparing cost-benefit ratios. All values must be calculated in terms of money, on a per person basis, on a yearly basis, and with all possible costs and benefits included. Some examples of costs often improperly omitted are: pollution and erosion of farmland, installation of electrical and other services, and value of food crops lost to growing of cash crops. Examples of benefits often left out are: earnings of workers freed from farming and working as craftsmen and value of bartered food crops. Formulas are given for calculating benefits, costs of irrigation systems, annual cost of each irrigation worker, annual costs of machinery, and yearly labor cost savings. (Cassar-FRC)

W82-00772

**WATER QUALITY MANAGEMENT IN RIVER BASINS: US NATIONAL EXPERIENCE,**  
North Carolina Dept. of Natural Resources and Community Development, Raleigh.

For primary bibliographic entry see Field 6E.  
W82-00800

**ECONOMIC ANALYSIS OF GRANULAR-BED FILTRATION,**

Syracuse Univ., NY. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5F.  
W82-00975

**TREATABILITY MANUAL: VOLUME IV. COST ESTIMATING.**

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
For primary bibliographic entry see Field 5D.  
W82-01076

**AN INTANGIBLE BENEFIT OF WATER POLLUTION CONTROL PROGRAMS,**

Rockwell International, Pittsburgh, PA.  
L. L. Moore.

Journal of Environmental Health, Vol 42, No 5, p 254-257, March/April, 1980. 5 Ref.

Descriptors: \*Water quality control, \*Cost-benefit analysis, \*Public health, Cost analysis, Economic aspects, Costs, Decision making, Planning, Water pollution control.

Benefit analysis is discussed in the context of problems which confront environmental regulatory agencies in placing a dollar value on water pollution control measures, specifically on benefits related to improved health. Applying theoretical concepts to practical problems is difficult, time-consuming, and may require an extensive data base. Often the policy maker who expects exact information concludes that cost-benefit analysis does not deal adequately with problems. The ability to identify problems and quantify the benefits of water pollution control must be improved. One reasonable manner to include intangible benefits in the decision making process is to describe them in non-monetary but quantitative units. These explicit descriptions may provide information on the importance of the impact, even though their monetary value may still be beyond measurement. Economic assessment of human illness associated with drinking water is highly subjective. It is also difficult to place a value on a person's change in life expectancy. Disruption of the use of time is the most costly of all effects caused by illness. Some researchers have estimated the national benefits that would accrue from the reduction of waterborne communicable diseases such as hepatitis and typhoid fever. The major advantage of cost-benefit analysis may be in learning how to justify the value placed on particular outputs of a proposed policy or program. Such attempts will encourage debate and facilitate the evolution of improved analytical approaches. (Baker-FRC)

W82-01092

### 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

**PRICE ELASTICITIES FOR WATER: A CASE OF INCREASING BLOCK RATES,**  
Arizona Univ., Tucson. Dept. of Economics.  
R. B. Billings, and D. E. Agthe.  
Land Economics, Vol 56, No 1, p 73-84, February, 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: \*Water demand, \*Water rates, \*Mathematical models, Economic aspects, Prices, Pricing, Prediction, Mathematical equations, Municipal water, Elasticity of demand.

The presence of block rates in rate schedules has been ignored in several previous studies of price elasticity of demand for residential water. When block rates appear in the rate schedule, use of average price as the only price variable in the estimating equation tends to result in excessively large estimates of the price elasticity of demand, especially when the marginal price increases while the intramarginal rates remain constant. When marginal price is used alone in the presence of block rates, the income effects of a change in intramarginal rates with marginal price constant cannot be accounted for properly. Two studies have suggested an alternative method utilizing two price-related variables in the estimating model when rate schedules contain block rates. Several alternative versions of the model for price elasticity of demand for water when increasing block rates and/or availability of service charges appear in the rate schedule were tested using both nominal and deflated price and income data. The model uses two price-related variables: the marginal price of water and a second price variable defined by Nordis as the difference between the consumer's actual utility bill and what would have been paid if all units of the commodity had been purchased at the marginal price. Estimation of the price elasticity of demand for residential water in Tucson, Arizona, using both double logarithmic and linear equations demonstrated that the two-price variable model produces better predictions of consumer response to rate schedule changes than those resulting from a single price model. The use of real monetary values produced substantially stronger statistical results than the use of unadjusted prices and incomes, indicating that water consumers responded to the real price of water and real income levels rather than to their nominal counterparts. (Carroll-FRC)

W82-00536

### FUNDAMENTAL ECONOMIC ISSUES IN THE DEVELOPMENT OF SMALL SCALE HYDRO.

Franklin Pierce Law Center, Concord, NH.  
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-02, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-02, May 1980. 26 p.

Descriptors: \*Institutional constraints, \*Hydroelectric plants, \*Economic feasibility, \*Regulations, \*Cost analysis, Construction costs, Operating costs, Dams, Resources development, Profits.

The costs of construction and revenues from operation of a small scale hydroelectric site have been identified, along with a range of estimates which included a profitable operation for sites with the given characteristics. Surveys of several sites show that these characteristics do exist, yet these sites have not been developed. By residual analysis, the cause was attributed to institutional costs. A rough look at the relative prices associated with hydroelectric generation reached the same conclusion. Since regulatory costs are unknown, it is difficult to place much confidence in an analysis attributing the impediment to hydro development to such regulatory costs. The present information on regulatory costs imposed on the small scale hydroelectric developer is insufficient to aid policy formation. It is neither feasible nor desirable to remove all regulation, but must be determined where in the regulatory environment these costs can be reduced with a net benefit to society. The relevant

## WATER RESOURCES PLANNING—Field 6

### Water Demand—Group 6D

questions are: where the regulation is inefficient at obtaining its stated goals; and what policy options are available to remedy this institutional problem. (Moore-SRC)  
W82-00722

#### POTENTIAL POLITICAL INFLUENCES AFFECTING THE WATER INDUSTRY.

R. C. Marini.  
Journal of the New England Water Works Association, Vol. 94, No. 2, p 170-179, June, 1980.

Descriptors: \*Political aspects, \*Utilities, \*Public participation, Public policy, Administrative decisions, \*Water policy, Public relations, Policy-making, Attitudes, Financing, \*Pricing, Water rates, Massachusetts.

Increasing consumer awareness and federal involvement are putting new political pressures on local water industries. The Boston Water and Sewer Commission raised its rates 48% in 1978 to clear a long standing deficit. When rates were rolled back in 1979, there was great public and news media involvement pressing for an even greater rate decrease. Small town public works officials feel even greater effects from public pressure to reduce costs or defer expansion in spite of the truth that most projects must be carried out eventually, either turned back to the individual or deferred into the future. In some cases absence of leadership in the utility has caused service to deteriorate to the extent that customers refuse to pay their bills, further decreasing revenue. The water industry must take political leadership by having sound plans and budgets and providing detailed information to consumers. Aiding this process are the focus on inflation and cost of living, separation of water and sewer charges from property taxes, and the visibility of water issues in the federal government. (Cassar-FRC)

W82-00861

#### 6D. Water Demand

##### EUROPEAN COMMUNITIES DIRECTIVE RELATING TO THE QUALITY OF WATER INTENDED FOR HUMAN CONSUMPTION,

Commission of the European Communities, Brussels (Belgium).

J. Smeets, and R. Amavis.

Water, Air, and Soil Pollution, Vol 15, No 4, p 483-502, May, 1981. 8 Tab.

Descriptors: \*Water quality control, \*Standards, Quality control, \*Potable water, Regulations, Planning, International agreements, International commissions, Water supply.

The Council of Ministers in the Action Programme of the European Communities of the environment presented a directive to the Council of Ministers of the European Communities on July 22, 1975, concerning the maintenance of a specific quality of water for human consumption. The directive contained a choice of a series of parameters, the numerical values given to them, and the measures relating to the monitoring and supervision needed to establish this degree of water quality. The parameters involved are classified in five classes: organoleptic parameters, physicochemical parameters, parameters concerning substances undesirable in excessive amounts, parameters concerning toxic substances, and microbiological parameters. The technical aspects of the directive are described. (Baker-FRC)

W82-00506

THE AZOV SEA PROBLEM,  
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.  
For primary bibliographic entry see Field 6G.  
W82-00651

##### ENVIRONMENTAL ASPECTS OF RURAL DEVELOPMENT WITH PARTICULAR REFERENCE TO THE KEISKAMMA RIVER BASIN STUDY,

Secretary for Agriculture and Forestry, Ciskei (South Africa).

G. F. Godden, S. M. Nicol, and A. C. Venn.  
Civil Engineer in South Africa, Vol 22, No 5, p 111-116, May, 1980. 3 Fig, 1 Tab.

Descriptors: \*Water resources development, \*Planning, Water demand, Rivers, River basins, Catchments, Keiskamma River Basin, \*South Africa.

The Keiskamma River rises at an elevation of 1,500 meters in the Amatole Mountains, at the southern tip of the Drakensberg Range of Southern Africa, where it drains into a number of minor tributaries towards the more arid coastal plateau. Two distinct river valleys are formed at this lower elevation. The total area of the river basin is 2700 square kilometers of which about 85% experiences an annual rainfall less than 700 mm and about 60% in the lower and middle reaches has about 400 to 600 mm per year. The highest precipitation, 1400 mm, falls in the mountainous areas forming the northern preiphery of the catchment area. The need arose for a new water supply scheme to serve the developing industrial growth points at Dimbaza and Middeldrift. The Keiskamma River was the logical choice. However, the potential inundation of 400 ha of valuable agricultural land by the dam, the effects of the new irrigation scheme and possible further afforestation in the upstream catchment, the effects of the dam runoff and irrigation withdrawals in the lower catchment, and the obvious potential for new irrigation development immediately downstream of the dam were factors to be considered. The Keiskamma River Basin Study should serve as an example of the type of investigation required to ensure that development of rural areas is achieved in the most efficient manner and in harmony with the environment. (Baker-FRC)

W82-00685

##### WATER - ITS USE AND THE IMPLICATIONS FOR ARKANSAS AGRICULTURE.

1981. 190 p. 29 Fig, 18 Ref, 3 Append.

Descriptors: \*Agricultural hydrology, \*Water use, \*Competing use, \*State jurisdiction, Interbasin transfers, Water shortage, Water management, Multiobjective planning, Long-term planning, Water use efficiency, Alternative planning, Groundwater management, \*Arkansas.

In view of an intense interest in water use and the potential impact of public decisions on the agricultural use of water, the Arkansas Farm Bureau board of directors authorized an in-depth review of water resources, water rights law, and allocation procedures, for use by Farm Bureau members in formulating policy on the water issue. The report includes information on water sources, quality, supply, and management; an overview of water law; a list of agencies with responsibilities in water; and discussions of special issues involving Arkansas water. Arkansas has had an abundant supply of water in the past, and few conflicts over use. However, pressures may be mounting that will change this situation in the future. Agriculture must plan its role in possible future controversies. In determining the course of action for agriculture, it is important to decide whether or not water laws will provide protection for agriculture's needs. Arkansas needs a comprehensive water plan that will show statistically where the water exists in Arkansas; show present and future needs for this water, including agriculture trends; ensure that the quality of the water remains intact; and develop a procedure to help relieve acute water shortages. Regardless of decisions concerning the use of water within the state, there is the threat of exporting water to deficit areas outside the state. The principal objection to interbasin transfer is not its legality but its tremendous cost. State interests in this matter must be protected by the congressional delegation. (Garrison-Omniplan)

W82-00714

##### ARKANSAS WATER POLICY.

Water Policy Task Force, Little Rock, AR.  
Report, December, 1980. 34 p. 51 Ref, Append.

Descriptors: \*Water resources development, Groundwater management, \*Allocation of resources, Water demand, Long-term planning, \*Administrative regulations, Regional development, Water use, Competing use, Federal jurisdiction, State jurisdiction, Planning, Flood plain management, Water law, Legal aspects, \*Arkansas, \*Water policy.

As Arkansas' population grows and places new demands on finite resources, the need for effective resource management becomes increasingly critical. Decline of surface water and groundwater quality, depletion of groundwater supplies, pollution and hazardous waste disposals, and lack of coordination of water responsibilities among government agencies are all increasingly critical issues in Arkansas. A State Water Policy Task Force recommended that there be: (1) a Water Resources Council to monitor water policy implementation; (2) coordination with federal funding sources to serve community needs efficiently; (3) regional water supply systems; (4) use of Corps of Engineers lakes and natural impoundments; (5) water conservation; (6) monitoring of water quality of the Arkansas River to correct problems related to river disinfection; (7) a rate structure for new water systems that supports the project's operation and maintenance; (8) a permanent water operator training section in the Department of Health's training and licensing program; (9) routine and emergency well drilling permitted only after a community acquires a description of local aquifers from the Arkansas Geological Commission; (10) more groundwater studies; (11) legislation to give the state authority over surplus waters of the state and make decisions about interbasin transfers; (12) indepth studies of Arkansas water law. Additional recommendations were made regarding the quality of surface water, toxic and hazardous wastes, thermal discharge by industry, floodplain management, wetlands, stream preservation, and non-consumptive uses including transportation, recreation, and energy production. (Garrison-Omniplan)

W82-00715

##### WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH.

Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation. Report FERC-0084, August 1981. 70 p. 8 Fig, 18 Tab, 1 Append.

Descriptors: \*Hydroelectric plants, \*Water resources development, \*River basin development, \*Water demand, Diversions, Licensing, Municipal water, Irrigation water, Water supply, Jordan River basin, \*Utah.

The Jordan River basin covers approximately 3,450 sq mi in north central Utah, and extends southeasterly from the Great Salt Lake for about 86 mi. Mean annual precipitation varies from 10 in. in the valley to over 35 in. in the high Wasatch Mountains. Water is a scarce commodity in the basin and stream flows are heavily regulated. Flows are diverted to the Jordan River basin for irrigation, municipal and industrial purposes. There are 26,550 kw of installed hydroelectric capacity in the basin in 14 plants, but the dependable capacity is very low as each is subject to flow reduction due to a lack of water during the dry season and irrigation diversions. Over half of the capacity is in the Olmsted project and in the Deer Creek plant. The Olmsted project is the largest hydroelectric plant in the basin and is presently the subject of an application for a major license. Two competing applications have also been filed. The applications are similar in that each proposes to continue project operation as in the past and none proposes significant modifications. Power generation may ultimately yield to water supply in the use of the Olmsted project flows. After development of the Jordanelle Reservoir, other Bonneville Unit features, and increased demands in the Salt Lake City metropolitan area, the flow regime which provides water to the Olmsted project will change. It is expected that high winter flows to the project will be stored upstream. It is estimated that the Olmsted project can continue to operate for 20 years before its flow is reduced for water supply purposes to

## Field 6—WATER RESOURCES PLANNING

### Group 6D—Water Demand

the point where continued project operation becomes infeasible. (Moore-SRC)  
W82-00736

**STATE WATER USE AND SOCIOECONOMIC DATA RELATED TO THE SECOND NATIONAL WATER ASSESSMENT,**  
Oak Ridge National Lab. TN.  
A. D. Shepherd, M. E. Hodgson, J. Stewart, and K. A. Hake.  
Water Resources Council Report, October 1980. 154 p, 8 Fig, 34 Tab, 30 Ref, 4 Append.

Descriptors: \*Water use, \*Water supply, \*Water demand, \*Social aspects, \*Economic aspects, Public policy, Agriculture, Steam generation, Industrial water, Domestic water, Prediction.

Data generated in the Second National Water Assessment was organized by 106 hydrologically oriented Assessment Subregions (ASR's). The ASR data have been converted to state boundaries to make them more suitable for use in state and federal policy analysis. The converted Second Assessment projections of water-use and related socioeconomic data are presented by state. Water use is divided into six functional areas, agriculture, steam electric, manufacturing, domestic, minerals, and commercial, in decreasing order of volume in 1975. In 2000 the order will be the same but for reversal of manufacturing and domestic. Manufacturing is the only sector to show a decline in use. Total consumption is predicted to increase about 26% by 2000, to a daily total consumption of 133015 mgd. (Brambley-SRC)  
W82-00739

**LONG DISTANCE MASS TRANSFER OF WATER,**  
Biswas and Associates, Oxford (England).  
A. K. Biswas.  
Water Supply and Management, Vol 5, No 3, p 245-251, 1981. 5 Ref.

Descriptors: \*Water transport, \*Water supply development, \*Water transfer, Conveyance structures, Water demand, Water resources development, Water allocation, Resource allocation.

Water use per capita has been increasing worldwide as the standard of living rises. The large scale artificial mass transfer of water from a water surplus region to a water deficient region in order to further the economic development of the latter is an important fact of modern life. A comprehensive assessment of available water resources, both surface and ground, must be made before entering into long distance transport. A second important consideration is the assessment of water demands for various purposes. Efficiency of water use is the third important consideration. Significant improvements could be made in the agriculture use of water, as it is sometimes extremely inefficient. The North American Water and Power Alliance has offered a program for mass transfer of water. The plan calls for the collection of surplus water from the high precipitation areas in northwestern North America and its distribution to water-scarce areas of Canada, the US and Mexico. A series of dams and power stations in Alaska and northern British Columbia would collect water and provide power to pump it up to the Rocky Mountain Trench Reservoir in southeastern British Columbia. Here the water would be lifted by pumps to the Sawtooth Reservoir in Central Idaho. From there it would flow by gravity to the western US. (Baker-FRC)  
W82-00858

**STATE OF WASHINGTON WATER QUALITY ASSESSMENT REPORT 1980.**  
Washington State Dept. of Ecology, Olympia.  
For primary bibliographic entry see Field 6E.  
W82-01067

### 6E. Water Law and Institutions

**THE WATERWAY THAT CANNOT BE STOPPED,**  
R. J. Smith.  
Science, Vol 213, No 4509, p 741-742, 744, August 14, 1981.

Descriptors: \*Inland waterways, \*Water transport, \*Costs, \*Construction, Tennessee River, Tombigbee River, Canals, Water policy, Water resources development, Judicial decisions, Legislation, Regulations, Political aspects, \*Legal aspects, Economic aspects, Mississippi River, Governmental interrelations, Waterways, Channel improvement, Corps of Engineers, Water quality, Erosion, \*Tennessee-Tombigbee waterway.

Construction of the Tennessee-Tombigbee waterway, now over half complete, has been challenged by Congress and court suits as too costly for the expected benefits. Congress is almost evenly divided on the issue of terminating the project, which has cost \$1 billion thus far, and suffering embarrassment or continuing it at costs of several more billion dollars and producing a waterway with questionable ability to save time and money in shipping. There are many hidden costs in the project-fish and wildlife impact, improvements to the Tombigbee River to remove bottlenecks, replacement of highways and bridges, and construction of facilities in the port of Mobile. A hurdle which may stop the project is the July 15 ruling that the Corps of Engineers had violated the National Environmental Policy Act and its own regulations by not preparing an impact statement showing that water quality, land erosion, and water stagnation problems would result. (Cassar-FRC)  
W82-00510

**THE TOXIC WASTE DUMP PROBLEM AND A SUGGESTED INSURANCE PROGRAM,**  
State Univ. of New York Coll. at Fredonia. Dept. of Economics.  
For primary bibliographic entry see Field 5E.  
W82-00591

**GROUNDWATER STRATEGIES,**  
For primary bibliographic entry see Field 5G.  
W82-00620

**THE CONTROL OF BACTERIAL POLLUTION CAUSED BY SEA DISCHARGES OF SEWAGE,**  
Wessex Water Authority (England).  
For primary bibliographic entry see Field 5D.  
W82-00699

**THE DESIGN AND INTERPRETATION OF MARINE POLLUTION SURVEYS,**  
Clyde River Purification Board (Scotland).  
D. Hammerton, A. J. Newton, and T. M. Leatherland.  
Water Pollution Control, Vol 80, No 2, p 189-203, 1981. 1 Tab, 23 Ref.

Descriptors: \*Pollution control, \*Estuarine environment, Surveys, \*Scotland, River Clyde, Coasts, Estuaries, Wastewater pollution, Heavy metals, Industrial wastes.

This paper reports on experience gained in marine pollution control in Scotland and in particular on the extensive studies carried out by the Clyde River Purification Board during the past fifteen years, approximately 1960-1975. Surveys were made of estuaries, coastal waters, bacteriological sampling conditions, outfalls, and special techniques used in monitoring studies. Detailed accounts are offered of the Irvine Bay survey. This area has become the target of major urban and industrial development, with the result that significantly greater loadings of domestic and industrial effluents now enter the bay. Pollution from the land included suspended solids and heavy loadings of nitrogen, phosphate, chromium, zinc, cadmium, and synthetic detergents, along with dieldrin, aldrin and BHC. Silicates, manganese, nickel, mercury and DDT were also identified. The impact was

naturally dependent on the mixing processes operating in the receiving waters. Pollution levels were analyzed on the beaches, in the sea water, in sediments, and in samples of biota. Monitoring programs were established. (Baker-FRC)  
W82-00700

**GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN,**  
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.  
November 1980. 522 p, 85 Fig, 92 Tab, 44 Ref, 3 Append.

Descriptors: \*Lakes, \*Comprehensive planning, \*International agreements, \*Water quality standards, \*Water quality management, \*Data collection, Water quality control, Hydrologic data collections, Pollution load, Pollution control, Eutrophic lakes, Eutrophication, Tributaries, Pollution abatement, \*Great Lakes.

Numerous agencies in Canada and the United States are responsible for determining the effectiveness of the Great Lakes' point source pollution abatement programs and the impacts of man's activities on the Lakes' ecosystem. The Great Lakes International Surveillance Plan, which presents the basic framework for surveillance activities in the Great Lakes basin as required by the 1978 Water Quality Agreement between the United States and Canada, was developed by the Surveillance Subcommittee over several years. The Surveillance Plan is a long-term strategy to coordinate the monitoring activities of the participating agencies in a cost-effective manner. It is characterized by quality assurance programs and the rapid exchange of comparable data among the various jurisdictions. Excessive inputs of nutrients and toxic substances have been and continue to be viewed with concern. The use of pesticides and toxic industrial compounds has, in many cases, been severely restricted or abolished. Further preventive measures aimed at screening new compounds and handling hazardous materials are being taken. This six-part document describes the overall plan in Section I, and the plan for each specific lake in Sections II through VI. Among the topics covered in each section are environmental issues, Tributary Surveillance, Point Sources, Atmospheric Inputs, Connecting Channels, Nearshore Surveillance, Water Intakes, Public Perceptions, Beach Monitoring, Levels and Trends in Open Lake Waters, Fish and Wildlife Contaminants, Radioactivity, and Data Quality. (Garrison-Omniplan)  
W82-00701

**PHOSPHORUS MANAGEMENT FOR THE GREAT LAKES: FINAL REPORT OF THE PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE,**  
International Joint Commission-United States and Canada, Windsor (Ontario).  
July, 1980. 129 p, 6 Fig, 9 Tab, 97 Ref, 2 Append.

Descriptors: \*Lakes, \*Water quality, \*Phosphorus removal, \*Chemical wastes, \*Phosphates, Mathematical studies, Wastewater treatment, Data collection, Ecosystems, Aquatic populations, Phosphorus compounds, International commissions, International agreements, \*Great Lakes basin.

By signing the 1978 Great Lakes Water Quality Agreement, the United States and Canada reaffirmed their intentions to restore and maintain the chemical, physical, and biological integrity of the Great Lakes basin ecosystem. As part of this agreement, the parties established tentative total phosphorus target loads. If these loads are confirmed by the State and Provincial Governments, they will be used as a basis for load allocations and compliance schedules for the two countries. To verify target loads and estimate lake responses to changes in phosphorus loads, various mathematical models were used. Using these data, the report suggests that improvements are needed in the estimates from point sources and tributaries, and in the methods of reporting the data. The strategies listed for assessing social and economic impacts of phosphorus control measures include regular collec-

## WATER RESOURCES PLANNING—Field 6

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tions of data on municipal and industrial water supplies, hydropower generation, property values, recreational use, and waterfowl habitat; establishing an Advisory Committee to provide program input and a coordinated mechanism between the U.S. and Canada to develop a comprehensive design system; and developing a social profile to record knowledge, beliefs, media reports, and leadership of the public involved. A staged-approach phosphorus management program is also outlined. (Garrison-Omniplan)  
W82-00702

#### WATER - ITS USE AND THE IMPLICATIONS FOR ARKANSAS AGRICULTURE.

For primary bibliographic entry see Field 6D.  
W82-00714

#### EXECUTIVE SUMMARY: LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN THE SEVEN MID-WESTERN STATES.

Franklin Pierce Law Center, Concord, NH.  
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-08, Price codes: A05 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-08, May, 1980. 92 p.

Descriptors: \*Water rights, \*Hydroelectric plants, \*Riparian rights, \*Dams, \*Legal aspects, Regulations, State jurisdiction, Federal jurisdiction, Navigable waters, Liability, Taxes, \*Midwestern States, Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, Wisconsin.

The relationship of federal law and regulation to state law and regulation of small scale hydroelectric facilities was determined for Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia and Wisconsin. Of these, Illinois, Kentucky, Michigan, West Virginia, and Wisconsin follow the riparian theory of law. In Indiana, the title of abutting land owners on non-navigable watercourses extends to the center of the watercourse. On navigable waters, title to the bed is vested in the state. In Ohio, the title of abutting land owners on both navigable and non-navigable watercourses extends to the middle of the watercourse and includes the subaqueous soil. Direct and indirect regulation, taxation, liability, and the availability of loans are also covered for each state. For each of the seven mid-western states, a flow diagram of regulations for small dams is provided. Federalism permits both the federal government and the state government to regulate and license certain aspects of a developer's project. Principles of federalism often support a finding that the federal regulation in question will be superior to comparable state regulation, divesting the state of regulatory authority in a given area. (Moore-SRC)  
W82-00718

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN ILLINOIS.

Franklin Pierce Law Center, Concord, NH.  
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-09, Price codes: A05 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-09, May, 1980. 80 p, 95 Ref.

Descriptors: \*Hydroelectric plants, \*Dams, \*Legal aspects, \*Water law, Riparian rights, Dam failure, Flood damage, Jurisdiction, Regulations, Liability, Utilities, Taxes, Natural flow doctrine, \*Illinois.

Illinois follows the riparian theory of water law, so that the right to utilize the flowing water at a proposed site is dependent upon the acquisition of property interests in the abutting land on both sides of the waterway, and the title to the stream bed. The title to all navigable lakes and bodies of water is vested in the state. In Illinois, to be navigable, a stream must furnish a common passage capable of carrying commerce of practical utility to the public. Use of the water is governed by the natural flow doctrine, tempered by allowing for a reason-

able use of the water. A dam owner may be held liable for all damage which results from dam breach or backflooding, unless it was caused by a reasonably unforeseeable act of God. Hydroelectric dams are not directly regulated by the state of Illinois as individual entities, but the state regulates the construction and operation of dams in general, and all public utilities are regulated. In addition, municipalities, water districts, and counties also have certain powers over the use of water and watercourses within their jurisdiction. There are many other agencies and regulations which may, in certain circumstances, affect or be of interest to small scale hydroelectric development. Financial considerations in development in Illinois include: property taxes, real estate transfer tax, public utility tax, corporate franchise tax, corporate income tax, and financial assistance programs. (Moore-SRC)  
W82-00719

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN RHODE ISLAND.

Franklin Pierce Law Center, Concord, NH.  
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-11, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-11, May, 1980. 49 p, 83 Ref.

Descriptors: \*Hydroelectric plants, \*Dams, \*Legal aspects, \*Water law, Taxes, Construction, Riparian law, Licensing, Wetlands, Utilities, \*Rhode Island.

Rhode Island appears to follow the reasonable use theory of riparian law. Title to the bed of a stream turns upon a determination of whether or not the stream is navigable. Navigable streams in Rhode Island are limited to those which are subject to the ebb and flow of the tide. If a stream is navigable, title to the bed is held by the state. Under the Mill Dam Act, a riparian proprietor is entitled to construct a dam for the purpose of generating power. There are no Rhode Island cases that address address dam breach. The Department of Environmental Management (DEM) is the most significant administrative agency with regard to dam construction, alteration and operation in the state. DEM approves all plans and specifications for the construction or substantial alteration of dams and reservoirs. Since DEM is the central administrative agency with respect to these statutes, the consequence has been an essentially one-stop licensing procedure. Wetlands, historic sites and archaeological resources are protected in Rhode Island. The Public Utilities Commission is vested with the judicial attributes of ratemaking and regulation, while the Division of Public Utilities and Carriers handles the remaining administrative functions. The extensive regulation of public utilities presents a significant cost to the developer. Owners and developers of dams will be required to pay property taxes based on the full and fair cash value of the dam, dam site, and machinery used to operate the dam. (Moore-SRC)  
W82-00720

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW HAMPSHIRE.

Franklin Pierce Law Center, Concord, NH.  
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-12, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-12, May 1980. 48 p, 100 Ref.

Descriptors: \*Hydroelectric plants, \*Legal aspects, \*Water law, \*Dams, Riparian rights, Regulations, Construction, Fish ladders, Eminent domain, Permits, Assessments, \*New Hampshire.

The regulatory system for construction and operation of low-head hydroelectric dams in New Hampshire is comparatively simple. Provided the developer avails himself of the 5 megawatts exemption, his main regulatory agency will be the Water Resources Board. The developer must acquire both river banks, the river bed and the land

needed for the impoundment. Methods of acquisition include eminent domain and the Mill Dam Act. In New Hampshire, it is the set of common law principles of riparianism that will determine the developer's rights in the water. The developer contemplating the construction of a dam with a developed output capacity of not more than 5 megawatt is exempt from all rules, regulations and statutes applying to public utilities. Exemption results in avoidance of a complex and costly regulatory process. Alterations to the watercourse require a permit from the special board. In addition the placement of the dam may constitute an obstruction in the watercourse, requiring a determination of the need for a fishladder. Once construction is complete and the dam is operational, the entity will be subject to investigations, inspections, rate setting, and liability that will span the life of the dam. There does not appear to be any rigid formula which can be used to arrive at the full and true value of a hydroelectric facility for tax assessment purposes. (Moore-SRC)  
W82-00721

#### STATE WATER USE AND SOCIOECONOMIC DATA RELATED TO THE SECOND NATIONAL WATER ASSESSMENT.

Oak Ridge National Lab, TN.  
For primary bibliographic entry see Field 6D.  
W82-00739

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW JERSEY.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-16, May 1980. 73 p, 1 Fig, 84 Ref, 4 Append.

Descriptors: \*Hydroelectric power, \*Institutional constraints, \*Legal aspects, \*Regulations, Economic aspects, Legislation, Taxes, Utilities, Dams, State jurisdiction, \*New Jersey, Water rights, Permits.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. New Jersey follows the riparian theory of water law, but the rights to use of the water seem to follow both the natural flow theory and the reasonable use theory. There is no Mill Dam act but common law generally affords the same protection. Only in the case of negligence will a dam owner be held liable for damage resulting from a breach. Once a developer has obtained the requisite property rights, a dam construction permit must be obtained from the Division of Water Resources within the Department of Environmental Protection, although this requirement may be waived in certain circumstances. Small-scale hydro projects are subject to the Department of Energy and the Board of Public Utilities, which regulates the finances and sets rates for public utilities. Projects may be affected indirectly by other regulations of the Department of Environmental Protection. The Delaware River Basin Commission has jurisdiction over hydroelectric development within the basin, and issues permits for development. Small-scale hydro projects are subject to franchise, excise, gross receipts and local real estate taxes, but are eligible for loans from the New Jersey Economic Development Authority. (Brambley-SRC)  
W82-00742

#### SUMMARY OF THE MID-ATLANTIC CONFERENCE ON SMALL-SCALE HYDROPOWER IN THE MID-ATLANTIC STATES: RESOLUTION OF THE BARRIERS IMPEDING ITS DEVELOPMENT.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-04, May 1980. 95 p, 6 Append.

Descriptors: \*Hydroelectric power, \*Legal aspects, \*Institutional constraints, \*Economic aspects, Financing, Licensing, Investment, Jurisdiction, Taxes, \*Mid-Atlantic States.

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

Legal and institutional obstacles and the lack of rational incentives for development are considered to be the major impediments to small scale hydroelectric development at this time. One of the major problems in financing a project is the negative cash flow shown for the pre-operating and early operating stages of the project. Ways to make hydroelectric projects more attractive to a developer and potential investors include: allowing a shorter amortization period; increasing the investment tax credit to 20%; and allowing investment tax credit for environmental enhancement devices. There is a need for a simplified and expeditious licensing process by state regulatory agencies. The lead agency concept is preferable to other methods if one permit form could be developed, and all other state agencies make full and significant contributions. One-stop licensing created permit delay, and states using the one-stop procedure had problems in implementing the process. The importance of identifying the interests of all parties affected by small scale hydro development was underscored in view of the time delays occasioned by litigation and administrative mediation of disputes. Federal incentives to small scale hydro development are financial, including feasibility grants, construction grants, low-interest loans and investment tax credits. It is proposed that the federal jurisdiction over small scale hydro be delegated to the states. (Moore-SRC)  
W82-00743

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN VIRGINIA, Franklin Pierce Center, Concord, NH.

Department of Energy Report DOE/RA/04934-15, May 1980, 50 p., 1 Fig., 43 Ref.

Descriptors: \*Hydroelectric power, \*Institutional constraints, \*Legal aspects, \*Regulations, Legislation, Economic aspects, Taxes, State jurisdiction, Riparian rights, Utilities, Dams, Licenses, \*Virginia.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. The theory of riparian rights followed in Virginia is one of reasonable use, to the mean low-water mark on navigable waters. The Milldam Act allows a riparian owner to build a dam across non-navigable waters. Only public utilities may use the power of eminent domain. Before constructing a dam for hydroelectric power generation, a developer must obtain a license from the State Corporation Commission, and if the developer is a public utility, a certificate of convenience and necessity. Public utilities are subject to the Commission for rate setting. Numerous state regulations have an indirect impact on hydroelectric power projects because of the impact of the project on the environment, as do the Potomac River Basin Compact, the Ohio River Valley Water Sanitation Commission, and the Ohio River Basin Commission. A negligence theory has been followed, but there is a trend toward use of the strict liability theory for dam breaches. Taxing of a small-scale hydroelectric project depends on its classification as a public service corporation or as a private business enterprise. Financial incentives include the availability of loans from the division of Industrial Development and the Virginia Industrial Building Authority. (Brambley-SRC)  
W82-00744

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN MARYLAND.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-18, May 1980, 68 p., 1 Fig., 79 Ref.

Descriptors: \*Hydroelectric power, \*Institutional constraints, \*Legal aspects, \*Regulations, State jurisdiction, Utilities, Water rights, Economic aspects, Taxes, Planning, Dams, Legislation, \*Maryland.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction and also from state law. In Maryland title to all navigable waters and to the soil below the high-water mark is vested in the state, but owners of adjoining land have riparian rights. Riparian rights extend to the center of a non-navigable stream. There is no public trust doctrine but the power of eminent domain may be used to obtain land for public use. Hydroelectric plants are regulated and supervised by the Public Service Commission and the Department of Natural Resources. These agencies are required to conduct long range studies of power plant sites and estimate future electric power demand. Hydroelectric power development may be affected by subagencies of the Department of Natural Resources through its regulations concerning wetlands, flood control, sediment and erosion control, pollution control and abatement, scenic and wild rivers, and archeological protection. The Public Service Commission sets rates for public utilities. There is no Mill Dam Act, and the theory of strict liability is used in cases involving breaches of dams. Hydroelectric projects are eligible for loans from the Department of Economic and Community Development, and subject to gross receipts, sales, use, real and personal property taxes. The Potomac River Basin Commission and the Susquehanna River Basin Commission are the two interstate compacts affecting Maryland's waters. (Brambley-SRC)  
W82-00745

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN WISCONSIN, Franklin Pierce Law Center, Concord, NH.

Department of Energy Report DOE/RA/04934-19, May 1980, 78 p., 1 Fig., 53 Ref.

Descriptors: \*Hydroelectric power, \*Institutional constraints, \*Legal aspects, \*Regulations, Economic aspects, Legislation, Water rights, Utilities, Taxes, Dams, \*Wisconsin.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction and also from state law. In Wisconsin a riparian owner owns to the middle of the bed of both navigable and non-navigable streams although on navigable streams the title is subject to the public right of navigation. Riparian owners have a right to reasonable use of the water, and dam owners are subject to the negligence theory in cases of damage resulting from dam breaches. The Department of Natural Resources regulates hydroelectric projects through 6 District offices which are responsible for all environmental concerns, and the Public Service Commission sets rates and supervises the financial affairs of those projects designated public utilities. Small scale hydroelectric projects are subject to municipal and county zoning powers, and may be affected by environmental regulations, the Public Intervenor's office, historic preservation orders, and Regional Planning Commissions. Hydroelectric projects are subject to property, income, franchise, corporate organization, gross revenue, sales, and use taxes depending upon their designation as public utilities. Financial assistance may be obtained from Industrial Development Agencies or municipalities through the Promotion of Industry Act. (Brambley-SRC)  
W82-00746

#### A CASE STUDY ANALYSIS OF THE LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF THE HYDROELECTRIC POWER OF THE BOARDMAN RIVER AT TRAVERSE CITY, MICHIGAN.

Franklin Pierce Law Center, Concord, NH.

Department of Energy Report DOE/RA/04934-33, May 1980, 149 p., 83 Ref. 3 Append.

Descriptors: \*Hydroelectric plants, \*Legal aspects, \*Institutional constraints, \*Economic aspects, \*Dams, Regulations, Public opinion, Fish ladders, Cost analysis, Financial feasibility, \*Michigan.

In order to meet the need for expanded power sources the Boardman River is being considered by Traverse City and surrounding Grand Traverse County as a hydroelectric generating resource. Development of the Boardman River would occur at five dam sites: two existing dams previously generated hydroelectricity, as did a third before being washed out; one has never been used for generation, and the fifth is presently supplying power. A lack of public awareness of hydroelectric potential may be a barrier to hydroelectric development. Developers, particularly new developers such as the joint venture participants in this study, have a vital need for complete and reliable information about any intended hydroelectric development. When, as here, the developers experience substantial difficulty in becoming informed about what data is needed and how to obtain it, the project may incur substantial delay, opposition, and cost. If fish ladders are required for the dams in this system, the cost of the project will increase appreciably. In view of the perceived intensity of local public opposition to installation of the ladders, it is unlikely that development will be pursued if ladders are required. Inadequate legislative guidelines for review of hydroelectric projects in Michigan may produce permitting delays, licensing conditions and other impediments. Incentives to hydroelectric development in this case include: the feasibility grant program, the Michigan Energy Employment Act, municipal developer advantages, and the advantages of using existing dams. (Moore-SRC)  
W82-00747

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN INDIANA.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-27, May 1980, 65 p., 102 Ref.

Descriptors: \*Hydroelectric plants, \*Legal aspects, \*Water rights, \*Dams, Reasonable use, Riparian rights, Liability, Economic aspects, Taxes, Utilities, \*Indiana.

Indiana law follows the doctrine of riparianism. On navigable waters, a riparian only has title to the high water mark of the stream; title to the bed is vested in the state. Navigability is determined by the navigable in fact test. Indiana now follows the reasonable use doctrine. The right to use water may be gained by prescription. Both a Mill Dam Act and the power of eminent domain can be used to appropriate private property. There is confusion as to the liability of a dam owner for dam breach. The Division of Water issues construction permits for dams, except dams draining less than one square mile, less than 20 ft high, with less than 100 acre feet of water impounded. The Division of Fish and Wildlife may require a downstream minimum flow, fish ladders, and small boat passages under certain circumstances. The Division of Lakes and Streams has jurisdiction over lake levels of all public water lakes. Indirect regulation includes: environmental regulation; nature preserves; natural and scenic rivers; historic preservation; soil and water conservation; river valley compacts and river basin commissions; and municipal regulations. The Public Service Commission is an administrative board which regulates public utilities operating within the state. With the exception of municipal utilities, no power utility may operate in any municipality where a public utility is providing a similar service without obtaining a certificate of public convenience and necessity from the Commission. In Indiana, public utilities are not taxed much differently than private business enterprises. There is little incentive for hydroelectric development through state loans and funding. (Moore-SRC)  
W82-00748

## WATER RESOURCES PLANNING—Field 6

### Water Law and Institutions—Group 6E

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN OHIO.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-26, May 1980. 82 p, 111 Ref.

Descriptors: \*Hydroelectric plants, \*Dams, \*Legal aspects, \*Water rights, Eminent domain, Riparian rights, Economic aspects, Liability, Regulations, Natural flow doctrine, Reasonable use, \*Ohio.

The title of abutting land owners on both navigable and non-navigable streams extends to the middle of a stream and includes the subaqueous soil. If the stream is classified as navigable, title and ownership is subject to the public right of navigation. A river is classified as navigable based upon its capacity for use in transportation and commerce. The Ohio courts have combined the theories of natural flow and reasonable use. Ohio gives the power to appropriate private property to any company organized for the purpose of erecting or building dams across rivers or streams to raise and maintain a head of water for the generation of electricity. Giving an electric company the power of eminent domain greatly reduces the legal barriers to developing small scale hydroelectric power. A defendant is liable for negligence for the breach of his dam, but is strictly liable for water percolation and seepage, regardless of negligence. No dam may be constructed unless a permit has been issued by the Chief of the Division of Water, or the dam is exempt from a construction permit. A major utility facility cannot be constructed unless a developer has first obtained a certificate from the Power Siting Commission. Dam developers may also be subject to regulations regarding water pollution control, conservancy districts, watershed districts, and zoning. Indirect considerations include: endangered species; wild, scenic and recreational rivers; natural resources; historic preservation, Great Lakes Compact; Ohio River Sanitation Compact; Sanitary Districts; and the removal of mill dams. Small scale hydroelectric will be taxed as a public utility if it is classified as a public utility; otherwise it will be taxed as a private business enterprise. Loans may be available from the Department of Energy, the Ohio Development Financing Commission, or the Ohio Water Development Authority. (Moore-SRC)

#### ANALYSIS OF LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF LOW-HEAD HYDROELECTRIC POWER IN MAINE.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-20, May 1980. 69 p, 1 Fig, 81 Ref.

Descriptors: \*Hydroelectric power, \*Hydroelectric plants, \*Legal aspects, \*Regulations, Dam construction, Water rights, State jurisdiction, Inspection, Taxes, Economic aspects, \*Maine.

The purpose of this paper is to guide the developer of low-head hydroelectric dam construction and operation through the de facto regulatory system as it exists in Maine. Maine follows the riparian theory of water rights, so a developer must obtain rights to both river banks, by sale, lease, or use of the abandoned dam law or Mill Dam Act. These rights are subject to the public trust doctrine. It is suggested that the developer start the regulatory process with the Public Utilities Commission, which supervises power plants of more than 1,000 kw, and which will issue a certificate of public convenience and necessity. The Board of Environmental Protection must next give approval, and if the development is to be in an unorganized or deorganized township, a certificate is required from the Land Use Regulation Commission. Notice must be filed with the Department of Inland Fish and Wildlife or the Department of Marine Resources, as appropriate. Stream alteration, coastal wetlands, or great ponds permits are then required, before construction starts. Once the project is built it is subject to inspections and regulations by these agencies. Taxes are assessed by local assessors for property tax purposes. Financial assistance is available from the Office of

Energy Resources, and technical assistance from the State Development Office. It is suggested that a one-step procedure be developed within the Board of Environmental Protection to simplify the regulatory process. (Brambley-SRC)

W82-00750

#### A CASE STUDY ANALYSIS OF LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF THE HYDROELECTRIC POTENTIAL AT GOOSE RIVER, MAINE.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-32, May 1980. 85 p, 62 Ref.

Descriptors: \*Hydroelectric plants, \*Legal aspects, \*Institutional constraints, \*Dams, \*Economic aspects, Water level fluctuations, Reservoirs, Regulations, Site selection, Environmental effects, Public participation, \*Goose River, Maine.

The Goose River hydroelectric project is located on the Goose River in Maine, which flows from Swan Lake in the Town of Swanville through the city of Belfast to the sea. The project comprises a five dam system. A private developer proposes to use the 7,500 acre-feet of storage capacity of Swan Lake to run the four downstream power stations, generating 430 KW of total capacity which could then be sold to Central Maine Power. The impact of federal regulation on the project has been relatively minor. The Town of Swanville has intervened in the federal licensing process to express its concern regarding fluctuations in the level of Swan Lake. The Public Utilities Regulatory Policies Act (PURPA) mandate has not been significant because the purchasing utility has a history of small power purchases. Maine has two specific regulatory systems which produce a de facto regulatory system for small dams: a water management system and an energy regulatory system. The development of the Goose River Project has capitalized on the nonspecific nature of the regulatory system, bypassing most of the system by use of statutory exemptions and an artful selection of the project site. The process selected for resolving the lake level issue and its subsequent environmental effects is that of environmental mediation. Its primary advantage is the avoidance of a costly resolution through the courts. The Goose River Project is expected to show a profit for tax purposes in each year of operation. (Moore-SRC)

W82-00751

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN PENNSYLVANIA.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-17, May 1980. 67 p, 179 Ref.

Descriptors: \*Hydroelectric plants, \*Legal aspects, \*Dams, \*Water rights, Riparian rights, Dam construction, Utilities, Regulations, Taxes, Financial aspects, \*Pennsylvania.

There are three methods by which rights in water may be acquired in Pennsylvania: riparian ownership, prescription, and condemnation. A combination of the riparian doctrines of natural flow and reasonable use is used to determine the rights of riparian owners. The right to use water of any watercourse other than a navigable stream may be acquired by prescriptive rights, which are absolute and exclusive. Streams and rivers are held to be navigable in law if they are used as public trade routes. Title to the beds of navigable rivers and lakes is held by the Commonwealth in trust for the public. The Commonwealth may grant title to the beds of navigable streams to private persons, subject to the public trust and public rights. The Public Utility Commission and the Department of Environmental Resources directly regulate dam construction and hydroelectric power production and distribution. The power of eminent domain is limited to those public utilities which have been granted a certificate of public convenience by the Public Utility Commission. Virtually all existing environmental control authority is exercised exclusively by the Department of Environmental Re-

sources. Indirect regulation by the state is in the form of zoning, historic preservation, the Scenic Rivers Act, water pollution control, and river basin commissions. Hydroelectric developers are subject to a multitude of taxes and fees both prior to and after the hydro facility is operating. (Moore-SRC)

W82-00752

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN WEST VIRGINIA.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-22, May 1980. 126 p, 1 Fig, 66 Ref, 3 Append.

Descriptors: \*Hydroelectric power, \*Institutional constraints, \*Legal aspects, \*Regulations, Water rights, Taxes, Utilities, Permits, State jurisdiction, Dams, \*West Virginia.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. West Virginia follows the riparian theory of water law and reasonable use of the water by the riparian owner. There is no Mill Dam Act and it is not clear whether a hydroelectric development has power of eminent domain. A small-scale hydroelectric project developer must obtain approval from the Department of Natural Resources, specifically from the Coal Refuse and Dam Control Section. The Division of Fish and Game may require the construction of fish ladders. The Public Service Commission may require a certificate of public convenience and necessity, and will set rates upon completion. On some specified rivers, permits may be required under the Natural Streams Preservation Act. A state water quality certificate may be necessary. Indirect regulation may result from requirements for water pollution control, special districts, local and wetlands regulations, energy resources programs and historic preservation. After construction the project will be inspected on a continuing basis and the owner will be held liable under the negligence theory for breaches of the dam. Hydroelectric projects are subject to property, business and license taxes, and may be eligible for loans through industrial development agencies. The Potomac River Basin Compact, the Ohio River Valley Water Sanitation Commission and the Wheeling Creek Watershed Protection and Flood Prevention District Compact impact hydroelectric projects indirectly. (Brambley-SRC)

W82-00753

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW YORK.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-14, May 1980. 122 p, 1 Fig, 101 Ref.

Descriptors: \*Hydroelectric power, \*Institutional constraints, \*Legal aspects, \*Regulations, Permits, Economic aspects, Legislation, State jurisdiction, Water rights, Dams, Taxes, Utilities, \*New York.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. In New York land may be obtained by purchase, lease or grant by the state, or by the use of the eminent domain power of the state. A riparian owner has rights to reasonable use and diversion of flow of the water. The Public Trust Doctrine allows the state to require permits to be obtained by small-scale hydro developers; such permits are issued by the Department of Environmental Conservation. The owner of a dam is responsible only for negligence if the dam is breached. All hydroelectric projects are subject to the State Environmental Quality Review Act and require either an

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environmental impact statement or a negative declaration. The Public Service Commission regulates electric power facilities with respect to construction, finances and rates. Small-scale hydro projects are subject to consideration indirectly from a number of state agencies concerned with environmental protection and energy development, and five interstate compacts. Projects are subject to initial fees, income taxes, administrative expenses and real property taxes, and may obtain development funds from the state's Industrial Development Agencies. (Brambley-SRC)  
W82-00754

#### LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN DELAWARE.

Franklin Pierce Law Center, Concord, NH.  
Department of Energy Report DOE/RA/04934-13, May 1980. 108 p, 1 Fig, 75 Ref.

Descriptors: \*Hydroelectric power, \*Legal aspects, \*Institutional constraints, \*Regulations, Legislation, State jurisdiction, Water rights, Taxes, Economic aspects, Utilities, \*Delaware.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. Delaware law recognizes riparian owners rights to reasonable use of water between high and low water marks of navigable rivers, with the state having rights to the river bed between low water marks. The Mill Dam Act implies that there is a reasonable use approach to non-navigable waters. The Public Service Commission regulates public utilities with respect to construction, operation, rate setting, and financial reporting. There is no general provision granting utilities the power of eminent domain. The Department of Natural Resources and Environmental Control is responsible for granting permits for small-scale hydro projects, and enforcing their provisions. These projects will be subject to review by the Delaware River Basin Commission, to local zoning regulations, to Soil and Water Conservation District regulations, and to the Coastal Zone Act. Small-scale hydro projects may be affected indirectly by plans of the Office of Management, Budget and Planning, the Delaware Energy Office, the State Conservation Plan, and historical site locations. Financial considerations include the payment of a license fee, gross receipts tax, real property tax, income taxes, franchise tax, and additional taxes, but projects may be eligible for loans when substantial employment opportunities may result. (Brambley-SRC)  
W82-00755

#### FEDERAL PARTICIPATION IN LAND USE DECISION-MAKING AT THE WATER'S EDGE—FLOODPLAINS AND WETLANDS,

Economic Research Service, Washington, DC.  
Natural Resource Economics Div.  
B. H. Holmes  
Natural Resources Lawyer, Vol 13, No 2, p 351-410, 1980. 338 Ref.

Descriptors: \*Land use, \*Wetlands, \*Flood plains, Legal aspects, Decision making, Governmental interrelations, Water resources management, Local governments, Regulations, Legislation, Judicial decisions, Flood control, Water quality standards, Water pollution control, Nonstructural alternatives, Aquatic habitats, Flood insurance, Channel improvement, Dredging, Water law, Water policy, Coastal zone management.

Land use regulation, traditionally the prerogative of states and local governments, is increasingly a federal concern, particularly in the sphere of water resources. The National Environmental Policy Act and the Coastal Zone Management Act of 1972 are examples of the Congress' more recent attitudes toward protection of water resources. In the past the federal government has exerted control over shoreline land use through the statutes on navigable waters, over which it has jurisdiction. The

Federal Water Pollution Control Act Amendments of 1972 provide one example of this. Judicial decisions have promoted the extension of federal control over land use as it affects water quality. Uses of flood plains are also controlled by the National Flood Insurance Act of 1968, the Flood Disaster Protection Act of 1973, other legislation, and executive orders. Flood control projects, assistance in flood plain management, disaster relief, and flood plain acquisition are means of implementing these laws and regulations. A unified national wetlands protection management program is emerging from the piecemeal and fragmented jurisdictions, involving many federal agencies. Wetlands preservation is currently carried out through wetlands acquisition, providing migratory bird habitats through the Water Bank Program, the Corps of Engineers permit policy for construction activities (including dredging), small watershed management (discouraging channel improvement), the National Environmental Policy Act, and the Endangered Species acts. (Cassar-FRC)  
W82-00799

#### WATER QUALITY MANAGEMENT IN RIVER BASINS: US NATIONAL EXPERIENCE,

North Carolina Dept. of Natural Resources and Community Development, Raleigh.  
N. S. Grigg and G. H. Fleming.  
Water Science and Technology, Vol 13, No 3, p 31-42, 1981. 18 Ref.

Descriptors: \*Water quality control, \*Regulations, \*River basins, \*Nonpoint pollution sources, Water management, Water policy, Water law, Water pollution control, Rivers, Effluent standards, Economic aspects, Cost effectiveness, Industrial wastes, Sewage charge, Urban runoff, Construction, Agriculture, Administrative agencies.

Since the 1970's the U.S. water quality management program has been a matter of debate between supporters of the regulatory approach and supporters of the economics-based approach. However, the great attention paid to wastewater discharges has resulted in ignoring some of the major water quality problems non-point sources such as agriculture, storm water and construction. Water quality standards and effluent standards are used to determine the conditions of a discharge permit (NPDES) for all dischargers. The U.S. regulatory system features uniform minimum requirements, no fee for discharge in permitted amounts, and non-transferring. A major criticism of the regulatory approach is the large amount of administrative effort required, some of which is misdirected or ineffective. However, it is unlikely that the economics-based approach could achieve the control now desired in the U.S. In its purest form the economic approach equates marginal costs and benefits. While eliminating much office work in determining effluent limitations, it would require much more field work to determine the possible damages from various discharges. The economic incentive approach charges an amount which induces dischargers to treat effluent to the limits that would achieve the water quality objective. In the United States, water quality management has passed the point where major improvements would result from modest regulatory actions. Future concerns are nonpoint sources and disposal of toxics, sludges and treatment residuals. (Cassar-FRC)  
W82-00972

#### INTERSTATE CONFLICT OVER GROUND WATER: WISCONSIN-ILLINOIS,

Wisconsin Univ.-Oshkosh. Dept. of Geology.  
C. W. Fetter, Jr.  
Ground Water, Vol 19, No 2, p 201-213, March/April, 1981. 10 Fig, 6 Tab, 13 Ref.

Descriptors: \*Computer models, \*Aquifer management, \*Groundwater depletion, Groundwater reservoirs, Groundwater management, \*Wisconsin, \*Illinois, Legal aspects, Interstate groundwater use.

A computer model of an aquifer system was used to model the drawdown effects resulting from pumping in Illinois and Wisconsin as well as to predict the impact of different management plans

on groundwater levels. The practical sustained yield from the Cambrian-Ordovician aquifer is 46 million gal/day in Illinois and 34 million gal/day in Wisconsin. Pumpage in Illinois has exceeded practical sustained yield every year since 1958, while practical sustained yield was reached in Wisconsin in 1975. Greater drawdown in the Chicago pumping cone has changed the regional hydraulic gradient, and 9.3 million gal/day of groundwater is currently being drained from beneath Wisconsin. Model results indicated that at the Illinois-Wisconsin border in 1973, there was 265 feet of drawdown, of which 94 feet were due to Wisconsin pumpage and 171 feet due to Illinois pumpage. To reduce Illinois pumpage, Lake Michigan water could be allocated to groundwater users in Illinois. This could result in a reduction of Illinois pumpage to less than 46 million gal/day by 1985, and the rate of groundwater decline in the aquifer would decrease substantially. (Small-FRC)  
W82-00818

#### WESTERN COAL MINING IN THE 1980S: A STUDY IN FEDERAL/STATE CONFLICTS,

Dechert, Price and Rhoads, Denver, CO.  
D. H. Israel.  
Natural Resources Lawyer, Vol 13, No 3, p 581-612, 1981. 123 Ref.

Descriptors: \*Coal mining, \*Legal aspects, Watershed protection, Watersheds, Regulations, Federal jurisdiction, Governmental interrelations, Groundwater, Surface water, State jurisdiction.

The preservation of surface and ground water resources of mining areas is considered as it relates to the new federal requirements concerning coal mining and reclamation. Coal mining is the first mining industry required by federal law to show affirmatively that its activities would not materially injure the hydrologic balance of both off-site and on-site areas. The circumstances and legislative history behind the call for hydrologic balance rules are reviewed. Under the new regulations, the application or permit must contain the name of the watershed and location of the surface stream or tributary into which surface and pit drainages will be discharged. Cross-section maps or plans showing the location of any subsurface water and its quality, the location of the aquifers, the estimated elevation of the water table, the location of impoundments, location of any water treatment facility, and the locations of discharges to any surface water on or adjacent to the affected land must also be included in the permit application. A reclamation plan is also needed. The regulations also deem some areas as unsuitable for mining operations, e.g., the alluvial floor limitation. There have been some federal/state conflicts concerning the new regulations. In one court it was ruled that the Secretary of the Interior cannot regulate the states' regulatory programs to demand information in mining permit applications beyond those specifically enumerated in the Surface Mining Control and Reclamation Act of 1977. This particular decision reveals the widespread feeling among federal courts that SMCR and its federal regulators have gone too far in invading the traditional right of the states to exercise primary, if not exclusive, authority over essentially local land and water use issues. (Baker-FRC)  
W82-00972

#### EXPERIENCE GAINED WITH THE U.S. POLLUTION CONTROL POLICIES,

Alvord, Burdick and Howson, Chicago, IL.  
W. H. Richardson.  
Aqua, No 2, p 245-255, 1981. 4 Fig, 25 Ref.

Descriptors: \*Legal aspects, \*Water pollution control, \*Policy making, History, Administrative decisions, Federal jurisdiction, Political aspects, Government interrelations, \*United States, Legislation.

Water pollution control efforts in the United States are viewed chronologically from 1800 to the present. Until the end of World War II, all of the pollution control activities were under the control of individual state Boards of Health or Sanitary Water Boards. The Federal Government's only concern was foreign matter in harbor waters. The

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first Water Pollution Control Statute was established in 1956; this was the first time that funds were provided as Grants toward the construction of treatment facilities. The 1972 Clean Water Act established goals, deadlines and a management program. The next major change occurred in 1977. Special efforts were exerted toward toxic and hazardous substances. Other major laws bearing on pollution control included the 1974 Safe Drinking Water Act, and the 1976 Toxic Substances Control Act. The 1974 Safe Drinking Water Act recognized the effect of organic contamination in the nation's drinking water supplies. The Conservation and Recovery Act dealt with improvements of solid waste management and encouraged the recovery of materials and energy and their reuse. In the short time that pollution control policies have been in effect, benefits have fallen short of the expected targets. However, there have been benefits in the field of technology transfer. Federal incentives have speeded activity in the area of establishing water quality standards. With the government requirements, most local municipalities and systems no longer are masters of their own fate. Currently, concern about the possible contamination of groundwater sources is of utmost interest. (Baker-FRC)

W82-00996

#### ENFORCEMENT UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976,

R. A. Weiland.

Boston College Environmental Affairs Law Review, Vol 8, No 3, p 641-678, 1980. 344 Ref.

Descriptors: \*Regulations, \*Legal aspects, \*Groundwater pollution, Federal jurisdiction, Conservation, Hazardous materials, \*Industrial wastes, Hazards, Water pollution sources.

The enforcement mechanisms made available to the federal government by the Resource Conservation and Recovery Act (RCRA) of 1976 to control the disposal of hazardous wastes are reviewed. Since no cases have yet been brought in which the government has used Section 7003 or Section 3008 of this act, the analysis is based on the overall language of the RCRA, its sparse legislative history, and on analogies to administrative interpretation and judicial construction of other, principally environmental, statutes. The Imminent Hazard provision is explored with discussion on the meaning of the term imminent or substantial endangerment, the special requisites for obtaining an injunction in light of the fact that the power to bring suit for equitable relief is granted in the statute, and finally, with regard to Section 7003, the relief that may be granted. Federal enforcement section of Subtitle C is discussed. Administrative and judicial enforcement options available to the government are considered, including compliance orders, civil penalties, and other civil actions. Finally, the criminal penalties provision is examined, including a discussion of entities against whom criminal sanctions may be sought and of the requirements for finding criminal liability. Interpretation is expected to parallel similar passages in the Clean Water Act. W82-01013

**DISTRIBUTION SYSTEM LIABILITY,**  
Waukesha Water Utility, WI.  
For primary bibliographic entry see Field 5F.  
W82-01028

**FREEDOM FROM THE NAVIGATION SERVITUDE THROUGH PRIVATE INVESTMENT,**  
C. E. Larsen.  
Nebraska Law Review, Vol 59, No 4, p 1073-1092, 1980. 107 Ref.

Descriptors: \*Judicial decisions, \*Navigation, \*Legal aspects, Navigation canals, Navigable waters, Public access, Remedies.

Federal regulatory control over the navigable waters of the United States derives from the commerce clause of the Constitution. As a corollary of the federal regulatory power over interstate commerce, previous decisions of the U.S. Supreme

Court have held that private property interests obstructing the free flow of navigation over navigable waters are subject to destruction or confiscation by the government without compensation. This burden on property interests, known as the federal navigation servitude, has been applied often, but not consistently, by the Supreme Court, with inequitable results. In *Kaiser Aetna v. United States*, 100 S. Ct. 383 (1979), the Supreme Court ruled that special circumstances may limit the power of the U.S. Congress over navigable waters of the United States in a manner negating the no compensation rule of the navigation servitude. Factors contributing to the Court's refusal to apply the navigation servitude no compensation rule included the effect of private investment in the improvement of the navigability of the waterway, the waterway's status under state law, and the conduct of the Army Corps of Engineers in approving the development of the waterway. A second case, *Vaughn v. Vermillion Corp.*, 100 S. Ct. 399 (1979), decided the same day as the *Kaiser Aetna* case, involved public access to canals dug on private land by private investors. This decision clearly stated that artificially constructed waterways are not subject to a public right of access. The *Kaiser Aetna* decision determined, in effect, that the navigation servitude is not coextensive with the navigable waters of the United States for commerce clause purposes, but did not resolve the question of the effective reach of the federal navigation servitude. (Carroll-FRC)

W82-01030

#### FEDERAL WATER RESOURCES RESEARCH: A REVIEW OF THE PROPOSED FIVE-YEAR PROGRAM PLAN.

National Research Council, Washington, DC. Water Resources Research Review Committee. Available from the National Technical Information Service, Springfield, VA 22161 as PB82-135559, Price codes: A05 in paper copy, A01 in microfiche. National Academy Press, Washington, DC. 1981. 75 p, 19 Tab, 11 Ref, 2 Append. OWRT-C-0086-G(04260(1), 14-34-0001-04260

Descriptors: \*Federal water resources research, Reviews, \*Management planning, \*Research priorities, \*Alternative planning, \*Future planning, Education, Training, \*Multiobjective planning, Water Resources Institutes, Administrative agencies, Water resources development, \*Long-term planning, Institutions, Legal aspects, Social aspects, Political aspects, Economic aspects, Governmental interrelations, Federal jurisdiction, \*Five-year plans.

The Water Resources Research Review Committee was created by the Commission on Natural Resources of the National Research Council to perform this study, which provides the Office of Water Research and Technology, U. S. Department of the Interior, with assistance in the preparation of the five-year water resources research plan called for in the Water Research and Development Act of 1978. The Committee studied the 1975 assessment of the nation's water resources by the U. S. Water Resources Council and other recent reports that highlight pressing water problems. The Committee then developed criteria by which to determine the research areas of highest priority.

Using these criteria, the Committee identified thirty-one research areas where, in its judgement, emphasis should be placed in programming water resources research over the next five years in the continuing effort to see that the nation's water resources are used effectively to provide essential services. The thirty-one research areas are described in relation to the professional disciplines. An alternative listing related to problem areas is contained in an appendix. The Committee concluded that: (1) the research grant programs of the Office of Water Research and Technology can serve an important role in training researchers for the future; (2) the institutional areas (social, behavioral, economic, legal, and political) should be the subject of significantly greater research effort in the future; (3) funding for actual research is only about two percent of the funding (\$380 million) for all activities related to water resources by the federal government, a modest level considering the importance of water resources to the national well-

being; (4) an improved management system is required for water resources research if the objectives of the Water Research and Development Act are to be achieved; and (5) three types of federal water arrangements might be considered: a managed multiagency research program; a policy committee based in the Office of Science and Technology Policy in the Executive Office of the President; or a committee based in a reconstituted Water Resources Council.

W82-01051

#### ILLINOIS GROUNDWATER PROBLEMS AND NEEDS,

Illinois Environmental Protection Agency, Springfield, Div. of Land/Noise Pollution Control. For primary bibliographic entry see Field 4B. W82-01052

#### GROUNDWATER POLLUTION IN KENTUCKY: A STATUS REPORT,

Kentucky Dept. for Natural Resources, Frankfort. For primary bibliographic entry see Field 4B. W82-01053

#### GROUND WATER IN THE OHIO RIVER BASIN PORTION OF MARYLAND: PROBLEMS AND NEEDS,

Maryland Dept. of Natural Resources, Annapolis. For primary bibliographic entry see Field 4B. W82-01054

#### GROUNDWATER PROBLEMS AND NEEDS IN NEW YORK,

New York State Dept. of Environmental Conservation, Albany. For primary bibliographic entry see Field 4B. W82-01055

#### GROUNDWATER PROBLEMS IN NORTH CAROLINA,

North Carolina Dept. of Natural Resources and Community Development, Raleigh. For primary bibliographic entry see Field 4B. W82-01056

#### OHIO'S GROUND WATER RESOURCES AND PROBLEM AREAS,

Ohio Environmental Protection Agency, Columbus, Groundwater Div. For primary bibliographic entry see Field 4B. W82-01057

#### PENNSYLVANIA GROUND WATER PROBLEMS AND NEEDS,

Pennsylvania Dept. of Environmental Resources, Harrisburg. For primary bibliographic entry see Field 4B. W82-01058

#### GROUND WATER PROBLEMS VIRGINIA PORTION OHIO RIVER BASIN,

Virginia State Water Control Board, Richmond. For primary bibliographic entry see Field 4B. W82-01059

#### GROUND WATER PROBLEMS IN WEST VIRGINIA,

West Virginia Dept. of Natural Resources, Charleston, Div. of Water Resources. For primary bibliographic entry see Field 4B. W82-01060

#### STATE OF WASHINGTON WATER QUALITY ASSESSMENT REPORT 1980,

Washington State Dept. of Ecology, Olympia. Document 81-6, December, 1980. 57 p, 8 Fig, 8 Tab.

Descriptors: \*Water quality standards, \*Water quality control, \*Pollution effects, \*Water quality management, \*Long-term planning, Groundwater management, Ground water pollution, Surface

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

water, Pollution effects, Management planning, Industrial wastewater, Municipal wastewater, Comprehensive planning, \*Washington.

This biennial Water Quality Assessment Report provides an overview of the status of the chemical, biological, and physical properties of the waters of the State of Washington. The current status is that the water quality goal of "fishable/swimmable" waters is met in 45 percent of the segments in the state. Of the 31 percent not meeting the goal, the problems in 13 percent are due principally to non-point sources and those in 4 percent to point sources (municipal or industrial), and it is unknown whether the goal will be met in the near future. Until the mid-1970s, water quality management efforts were focused heavily on municipal and industrial discharges. Program emphasis is now shifting from categorical problems to priority geographic problem areas, which include Commencement Bay, Duwamish Waterway, Inner Grays Harbor, lower Yakima River and Spokane River. Water quality priority areas are Willapa Bay, Lake Chelan, Puget Sound, and Duwamish Waterway and River. The Puget Sound Study will be a multi-year program of plan development and implementation. Ground water quality monitoring and control is an increased state and federal priority, and a comprehensive management strategy is being developed by the state that will examine the need for ground water quality standards, a non-degradation policy, and control of sources through the state waste discharge permit program. This strategy will allow for coordinated development and operation of programs for underground injection control, on-site waste management, and storm water management. (Garrison-Omniplan) W82-01067

#### A CASE STUDY ANALYSIS OF LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE POTENTIAL HYDROELECTRIC DEVELOPMENT AT HIGH FALLS STATE PARK, GEORGIA.

Franklin Pierce Law Center, Concord, NH. Energy Law Inst. Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-34, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-34, May, 1980. 61 p, 1 Fig, 15 Ref. W82-00716

Descriptors: \*Hydroelectric power, \*Hydroelectric plants, \*Institutional constraints, \*Legal aspects, \*Economic aspects, Economic efficiency, Environmental effects, Dams, Reservoirs, Licensing, Electrical transmission, \*High Falls State Park, Georgia, Case studies.

There are four potential hydroelectric power sites at High Falls State Park, of which the old powerhouse site is the most favorable, economically and environmentally. The canal and penstock cradles already present would reduce construction costs. The legal requirement of keeping the water level in the reservoir constant mandates a run-of-the-river project, but this will reduce the environmental impact. A license will be required by the Federal Energy Regulatory Commission before the site can be used for hydroelectric power generation, and an environmental impact statement is part of the licensing process. The Georgia Department of Natural Resources has authority over hydroelectric projects, and, because of the age of the dam, is unlikely to license it without investigation and repairs. If the repairs are done, there seem to be few problems to use of the site, and electricity could be generated economically. There will be legal and functional problems if the Department of Natural Resources develops the site. These problems can be overcome if the Municipal Electric Authority of Georgia (MEAG) is the developer, and the MEAG has the advantage of existing power wheeling agreements, making it the most effective developer of the site. (Brambley-SRC) W82-01078

#### 6F. Nonstructural Alternatives

##### ARKANSAS WATER POLICY.

Water Policy Task Force, Little Rock, AR. For primary bibliographic entry see Field 6D. W82-00715

#### PROPOSED WATER QUALITY CONTROL PLAN FOR INDO SUBAREA OF THE WHITEWATER HYDROLOGIC UNIT, WEST COLORADO RIVER BASIN.

California Regional Water Quality Control Board, Palm Desert. Colorado River Basin Region. May, 1981. 62 p, 3 Fig, 12 Tab, Append.

Descriptors: \*Water management, \*Administrative decisions, \*Long-term planning, \*Water use, \*Multi-objective planning, \*Competing use, Water use efficiency, Aquifers, Aquifer management, Alternative planning, Water consumption, Ground-water management.

The proposed Water Quality Control Plan for the Indio subarea of the Whitewater Hydrologic Unit, West Colorado River Basin, was prepared as the first phase in updating the Plan for the Basin. For planning and reporting purposes, the Basin was divided into six major areas on the basis of economic and hydrologic characteristics: Lucerne Valley, Hayfield, Coachella Valley, Anza-Borrego, Imperial Valley, and Salton Sea. The Indio subarea is one of five within the Coachella Valley Planning Area, and its water quality issues are addressed in depth amid an overview of all six major planning areas. The groundwater in the Indio subarea lies principally in the alluvial deposits of the Coachella Valley. A deep aquifer is located along the entire length of the Valley from the San Gorgonio Pass to the Salton Sea. The area from Indio south also has a semi-perched zone resulting in a two-aquifer system; the deep aquifer is separated from the upper aquifer by an aquiclude. A comparison of 1970-75 and 1958-59 groundwater quality data for shallow wells shows an increase in total dissolved solids concentrations near Indio and an increase in total hardness southeast of Indio. High nitrate concentrations (approximately 200 mg/l NO<sub>3</sub>-) were found in the Indian Wells area prior to 1937, and were attributed to the decomposition of mesquite forests. Significant variations in water quality exist within the subbasin. (Garrison-Omniplan) W82-00716

#### FEDERAL PARTICIPATION IN LAND USE DECISION-MAKING AT THE WATER'S EDGE—FLOODPLAINS AND WETLANDS,

Economic Research Service, Washington, DC. Natural Resource Economics Div.

For primary bibliographic entry see Field 6E. W82-00799

#### COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,

Ishiko Univ., Moscow. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 4D. W82-00869

#### 6G. Ecologic Impact Of Water Development

##### LEAF LITTER PROCESSING IN A REGULATED ROCKY MOUNTAIN STREAM,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.

R. A. Short and J. V. Ward.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 123-127, January, 1980. 1 Fig, 2 Tab, 15 Ref.

Descriptors: \*Leaves, \*Litter, \*Environmental effects, \*Dam effects, \*Macroinvertebrates, \*Colorado River, Ecological effects, Streams, River systems, Mayflies, Microbial degradation, Temperature effects, Aquatic populations, Granby Dam.

The ability of regulated (dammed) streams to process leaf litter of alder was examined by the leaf litter pack method at sites before the Granby Dam

along the Colorado River. Similar studies conducted on sections of the undammed Fraser River were used for comparison. Leaf processing was studied during the autumn and winter with leaf packs attached to bricks and placed in riffles. Leaching controls were kept in the water two days, and five samples from each site were retrieved after 16, 38, 52, and 66 days. Macroinvertebrates collected from study sites were classified and counted and leaf processing was evaluated by comparing dry weights of remaining leaf packs after the end of the study period. Loss rate coefficients were much higher for leaves kept in regulated waters than in unregulated waters. These findings did not support the hypothesis that reductions in macroinvertebrate shredders would decrease leaf litter processing rates in regulated streams. It was suggested that the warmer winter temperatures below the dam compensated for the virtual absence of shredder species by increasing the microbial leaf degrading activities. (Geiger-FRC) W82-00542

#### THEORY OF ECOLOGICAL PREDICTION OF LIMNETIC ECOSYSTEMS,

Akademija Nauk SSSR, Moscow. Inst. Vodnykh Problem.

I. I. Nikolaevev.

Water Resources (English Translation), Vol 7, No 5, p 430-436, September/October, 1980. 48 Ref. Translated from Vodnye Resursy, No 5, p 100-109, September/October, 1980.

Descriptors: \*Limnology, \*Prediction, \*Ecosystems, Ecological effects, \*USSR, Reservoirs, Stream discharge, Europe, Species composition, Benthos, \*Reservoir construction.

The first period of active prediction of limnetic ecosystems in the Soviet Union is associated with intensive hydraulic engineering construction conducted between 1930 and 1950. Regular hydrobiological and ichthyological investigations conducted on all of the large reservoirs have made it possible to evaluate the correctness of the predictions. The species composition of pelagic and benthic communities of reservoirs on the Volga generally corresponds to predictions, although the observed intense invasions of elements of southern fauna northward and of northern fauna southward were unexpected. The predictions with respect to the formation of main communities were considerably less accurate. While the predictions indicated that pelophilous benthos should have been predominant in the reservoirs, with oligochaetes and other homotrophic fauna predominating in the benthos from the first years of existence, experience showed that heterotrophic fauna dominated colonization of the bottom of the reservoirs, with larvae of midges being the predominant species in the first years. There were no substantial deviations from the predictions of the development of the communities of micro- and macrovegetation of the flatland reservoirs. Quite substantial errors were made in predicting the productivity of individual communities. Predictions of the phytoplankton productivity were underestimated and that of the zoobenthos and commercial fishes overestimated for many reservoirs. Although many of the predictions were not accurate, long-term comprehensive investigations facilitated analysis of the principal causes of deviations from the predictions and promoted the formation of more realistic concepts about the processes of formation of lakelike ecosystems and the feasibility of their prediction. (Carroll-FRC) W82-00597

#### THE AZOV SEA PROBLEM,

Akademija Nauk SSSR, Moscow. Inst. Vodnykh Problem.

D. Ya. Ratkovich, V. E. Prival'skii, M. V.

Matushanskii, S. S. Remizova, and Yu. Yu. Marti. Water Resources (English Translation), Vol 7, No 4, p 304-320, July-August, 1980. 3 Fig, 6 Tab, 10 Ref. Translated from Vodnye Resursy, No 4, p 19-39, July-August, 1980.

Descriptors: \*Salinity, \*Water management, \*Water allocation, \*Azov Sea, Water consumption, Diversion, Volga River, Don River, Kuban

## WATER RESOURCES PLANNING—Field 6

### Ecologic Impact Of Water Development—Group 6G

River, Saline water intrusion, Saline lakes, Lakes, Reservoirs, Irrigation effects, Water conservation, Fisheries, Fish management, Hydroelectric plants, Reservoir releases, Water use, Navigable waters, Model studies, Agriculture, Canals, Water pollution control, Water transfer, Russia.

As water consumption increases in the heavily populated and industrialized Azov Sea Basin, river inflow and biogenic runoff decreases. This causes an increase in salinity via an inflow of Black Sea water and a deterioration of water quality and biological productivity. Projects to reduce nonreturnable losses include a sequence of low-head hydropower stations to maintain a uniform transport depth in the Volga-Don waterway, fishery projects, and limiting new irrigation according to available water. Nonreturnable water consumption in the Lower Don Basin will be 20% of the total for the entire Don Basin until 1990, then 15%. Plans for water management in the Kuban River Basin involve transfer of water from other basins, reducing the navigation season from 285 days to 140-145 days, and spawning releases for fish. A model is used to predict the salinity of the Sea at intervals up to 2010 under different variations of water consumption. These calculations show that the salinity of the Sea can be reduced to a favorable regime (9.5-10.5%) only by complete compensation of nonreturnable withdrawals. It is unlikely that fisheries and irrigated agriculture can continue to coexist until the end of the century. The effects of the proposed Kerch Strait hydroelectric project, between the Black and Azov Seas, have not been determined; but speculations are that salinity will increase, shoreline erosion will occur, anchovy migration will be disturbed, and salinity in the freshwater spawning areas will be unfavorably changed. (Cassar-FRC)

W82-00651

#### THE PONGOLO FLOODPLAIN: A UNIQUE ECOSYSTEM THREATENED,

Natal Univ., Pietermaritzburg (South Africa).  
J. Heeg, C. M. Breen, and K. H. Rogers.  
Civil Engineer in South Africa, Vol 22, No 5, p 125-128, May, 1980. 2 Fig, 1 Ref.

Descriptors: \*Flood plains, \*Dams, Levees, Weirs, Flood plain management, Flood plain zoning, Flood irrigation, Benefits, Ecosystems, Pongola poort Dam, \*South Africa.

The effects on the Pongolo Floodplain resulting from the construction of the Pongola poort Dam are examined. The Dam was constructed for the purpose of impounding the waters of the river for irrigation. This will result in an absorption of the floods which now regularly inundate the floodplain during the summer months. In examining the energy pathways and nutrient cycles of the Floodplain, two main spheres of marked flood dependence were isolated: allochthonous and autochthonous energy inputs, which are directly affected; and the fishes, an exploitable resource, which are indirectly affected through reduced energy input as well as being directly dependent on the floods in their breeding biology. The principal requirement for preserving the Pongolo Floodplain is sufficient water to flood the system, applied at the correct time to stimulate fish spawning. The amount of water required to maintain the floodplain pans at the maximum retention level is estimated at 26,000,000 cubic meters per year, based on an annual evaporation of 2,000 mm and a rainfall of 600 mm/year. However, the productivity depends on inundation of the whole area between the levees and the adjoining high ground for a reasonable period of time, and this would require an additional 100,000,000 cubic meters per year, which is 14.6% of the mean assured yield of the dam. It is estimated that, given inflatable weirs with reasonably sensitive control, the requirements can be met at an annual water cost of 42,000,000 cubic meters per year, a 67% saving on the natural flow-through system. (Baker-FRC)

W82-00684

#### FINAL ENVIRONMENTAL IMPACT STATEMENT: NORTH FORK STANISLAUS RIVER PROJECT NO. 2409 - CALIFORNIA

Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation. Report FERC/EIS-0011, June 1980. 297 p, 10 Fig, 28 Tab, 40 Ref, 8 Append.

Descriptors: \*Environmental Impact Statement, \*North Fork Stanislaus River, \*California, \*Hydroelectric power, \*Environmental effects, \*Electric power production, Dams, Tunnels, Transmission lines, Recreation, Flooding, Reservoirs, Wildlife habitats, Flow rates, Water quality, Social aspects, Cost-benefit analysis.

The Calaveras County Water District is proposing to construct a 205.2 MW hydroelectric project on the North Fork Stanislaus River, Stanislaus River, Highland Creek, Beaver Creek, Silver Creek, and Duck Creek in the vicinity of Arnold, California. It would require the construction of a dam, two powerhouses, three diversion dams, diversion tunnels, an afterbay dam, access roads, transmission lines, recreational facilities, and appurtenant facilities. About 2,848 acres of land would be occupied by the project, of which 2,723 acres are now Federal lands. Environmental impacts caused by construction and operation of the project would include: loss of 1865 acres of existing vegetation and wildlife habitat to the reservoirs; inundation of streams; altered flow and thermal regimes in the creeks and river; deterioration of water quality; loss of vegetation; temporary adverse impacts on air quality and ambient noise levels during construction; increased recreational use; effects on archeological sites; impacts of the increased labor force during construction; and changes in the visual resources. Alternative power sources using a combination of hydroelectric and fossil-fuel combustion were considered. The proposed project and the combination sources have the best benefit-cost ratios and would save various amounts of coal and oil. (Brambley-SRC)

W82-00737

#### FINAL ENVIRONMENTAL IMPACT STATEMENT: SWAN LAKE PROJECT NO. 2911 - ALASKA

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Report FERC/EIS-0012, April 1980. 189 p, 22 Fig, 16 Tab, 23 Ref, 3 Append.

Descriptors: \*Hydroelectric plants, \*Environmental impact statement, \*Dam construction, Water quality, Turbidity, Environmental effects, Wildlife habitats, Construction, Fish, Swan Lake, \*Alaska.

A 22 MW hydroelectric project on Falls Creek and Swan Lake near Ketchikan, Alaska, has been proposed. This would involve the construction of a dam located 0.75 miles downstream from the outlet of the existing Swan Lake: a power tunnel leading to an indoor-type powerhouse at tidewater on Carroll Inlet; a switchyard; an access road; a transmission line; and appurtenant facilities. Environmental impacts caused by construction and operation of the project would include: inundation of about 460 acres of existing vegetation and wildlife habitat; inundation of about 3.5 miles of spawning habitat used by kokanee and Dolly Varden; diversion of all waters, except flood and spillage waters, at the dam, from the natural Falls Creek channel to the powerhouse; clearing of about 250 acres of land; loss of wildlife habitat, and temporary disruption of resident wildlife species in or near construction sites; disturbance of about 20 acres of land in the lower Carroll Creek watershed for extraction and processing of aggregates; turbidity and siltation in surface waters receiving drainage from construction sites and the aggregate site; temporary adverse impacts on air quality and ambient noise levels; and changes in the characteristics of visual and recreational resources. Alternatives to the proposed action that were considered are: conservation and rate revision; alternative design arrangements; other sites; alternative forms of generating equivalent power; and denial of the application for license. (Moore-SRC)

W82-00738

#### MEASUREMENT OF PARTICULATES EXTRAINED IN SOME GREAT LAKES POWER

PLANT COOLING WATER: AN EXERCISE IN FUTILITY, Canada Centre for Inland Waters, Burlington (Ontario).

J. K. Leslie, and J. E. Moore. Environmental Pollution (Series A), Vol 22, No 3, p 179-185, July, 1980. 1 Fig, 3 Tab, 18 Ref.

Descriptors: \*Entrainment, \*Phytoplankton, \*Cooling water, Aquatic life, Measuring instruments, Great Lakes, \*Powerplants, Lakes, Particulate matter, Intakes, Outlets.

Suspended particles were measured in intake and discharge cooling water at three Great Lakes electric power generating stations. Using the Coulter Counter, the total number and volume of particles in the discharge water was found to have increased by 11% and 5%, respectively, and mean size decreased 3%. Image analysis showed an 18% increase in number, 22% decrease in surface area, and 10% in linear dimension. The inverted microscope technique showed a 22% increase in number of discharge particles and a 10% reduction in total biomass. The Coulter Counter detected three times as many particles as did the other two methods. To detect a statistically significant + over - 5% change in particle number the Coulter Counter method would require 2839 samples; the image analyzer, 1541; and the inverted microscope technique, 7021. Sample numbers in this study were much smaller, on the order of 25-50. It was concluded that significant results may be obtained only with a massive sampling program. (Cassar-FRC) W82-00782

#### GLEN CANYON DAM IS KILLING THE GRAND CANYON AND YOUR TAX DOLLARS ARE PAYING FOR IT.

J. Roberts. National Parks, Vol 55, No 7/8, p 18-25, July/August, 1981. 1 Fig.

Descriptors: \*Dams, \*Environmental effects, Dam effects, Electric powerplants, Environmental protection, Grand Canyon, Fish, Birds, Plants, Hydroelectric power, Erosion, Beaches, Beach erosion, Water level fluctuations, \*Reservoir releases, Surges.

Changes in the water level in the Colorado River as a result of manipulations at Glen Canyon Dam are discussed. These uneven releases of water through the Dam cause man-made tides to surge along the banks of the river, disrupting the naturally alternating erosion and redeposition of silt, enabling exotic species of plants to flourish on the banks while killing others that have been established there for years, eliminating some populations of birds, and allowing fish and eggs to be stranded far from the water when the surge has gone by. Beaches are washed away. The shallowness of the river at times prohibits groups of white water enthusiasts from completing their trips. Plans are in the works for making changes which will increase the destruction already being seen. These plans are being laid in supposed answer to increasing electricity needs, but opponents of the plans suggest that existing power plants could be used for far less money than will be required to make the changes, and without doing further environmental damage. (Baker-FRC) W82-00813

#### TOXIC DINOFLAGELLATES AND TIDAL POWER GENERATION IN THE BAY OF FUNDY, CANADA,

Institute for Marine Environmental Research, Plymouth (England).

R. C. Reid. Marine Pollution Bulletin, Vol 11, No 2, p 47-51, February, 1980. 2 Fig, 34 Ref.

Descriptors: \*Shellfish, \*Toxicity, \*Dinoflagellates, \*Tidal powerplants, Pyrrhophyte, Red tide, \*Bay of Fundy, Canada, Poisons, Public health, Plankton, Baseline studies, Planning, Prediction, Environmental effects, \*Ecological effects.

Although the need for an environmental impact assessment of the proposed tidal power generation

## Field 6—WATER RESOURCES PLANNING

### Group 6G—Ecologic Impact Of Water Development

plant to be constructed in the upper reaches of the Bay of Fundy in Canada has been discussed by other researchers, issues relating to public health and the economic effect on mariculture were not raised. The Bay of Fundy is one of three core areas for paralytic shellfish poisoning along the eastern seaboard of North America. Core areas are defined as areas in which high levels of toxicity exceeding 80 micrograms of toxin per 100 grams of shellfish tissue occur almost every year and in which severe illness, and in some cases death, due to paralytic shellfish poisoning have been recorded. This poisoning is derived from neurotoxins contained in certain dinoflagellates which are concentrated and transferred via filter feeding mollusks to humans. Previous studies have shown that the occurrence of dinoflagellates is intimately linked to the physical structure of shelf waters, with these organisms occurring most abundantly in frontal regions and in shallow thermoclines and occurring only in small numbers in well-mixed environments. The water circulation and tidal regime of the Gulf of Maine and the Bay of Fundy will be considerably altered by construction of the proposed tidal power station. These alterations could result in changes in the occurrence of toxic dinoflagellates and associated patterns and intensity of paralytic shellfish poisoning. Changes in turbidity and sedimentation characteristics which would result from the proposed power plant would also be favorable to increases in the numbers of toxic resting cysts and toxicity in the bottom sediments. (Carroll-FRC) W82-00908

#### GREAT LAKES ENVIRONMENTAL PROTECTION POLICIES FROM A FISHERIES PERSPECTIVE,

Canada Centre for Inland Waters, Burlington (Ontario).

M. G. Johnson.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1196-1204, July, 1980. 33 Ref.

Descriptors: \*Water resources development, \*Great Lakes, \*Environmental policy, Water quality management, Air pollution, Social aspects, Management planning, Long-term planning, Water supply development, Lake fisheries, \*Fish management, \*International waters.

International resource management plans and environmental protection policies of the Great Lakes may be categorized under the areas of water quantity and quality management, fisheries management, and air pollution abatement. Policy development often ignores the interaction of these departments and fails to deal with root causes of problems in a broad context. Ineffective use of socio-economic data hinders the implementation of remedial programs. Management policies are needed which reach across Great Lakes resource sectors to optimize a diversity of long-term benefits to society. Collaboration between the Great Lakes Fishery Commission and the International Joint Commission is recommended to identify issues, encourage strategic planning with resource sector and public participation, and adopt a broader outlook of societal goals and public policy in relation to the finite capacity of the Great Lakes ecosystem. (Geiger-FRC) W82-00978

#### FORMULATING ALTERNATIVES FOR ENVIRONMENTAL STUDIES,

Wheeler and Gray, Los Angeles, CA.

D. R. Boone.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 527-538, June, 1980. 17 Ref.

Descriptors: \*Alternative planning, \*Environmental protection, Planning, Management decisions, Environmental engineering, Design criteria, Legal aspects.

An overview of the legal requirements for the identification of alternatives to proposed civil engineering projects is presented. A procedure is of-

fered which enables alternatives to be formulated to provide the project engineer with a workable approach toward meeting the alternatives requirements of the National Environmental Policy Act (NEPA). In every recommendation or report on proposals for legislation and other major actions which affect the quality of the human environment the NEPA calls for the agencies of the Federal Government to include a detailed statement concerning environmental impact, possible adverse effects, alternatives to the proposed action, the relationship between local short-term uses and the maintenance and enhancement of long term productivity, and any irreversible and irretrievable commitments of resources which would be involved in the proposed action. Even so, the degree to which alternatives are seriously considered at the project management level varies, and inadequacies have been noted. Legal and institutional constraints tend to narrow the range of alternatives considered by project planners. A revised Council on Environmental Quality guideline is attempting further change in the way future projects will be planned. (Baker-FRC) W82-00997

#### MORPHOLOGICAL CHANGES OF RIVER CHANNELS CONSEQUENT UPON HEADWATER IMPOUNDMENT,

Loughborough Univ. of Technology (England).

G. E. Petts.

Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 374-382, July, 1980. 1 Fig, 5 Tab, 20 Ref.

Descriptors: \*Geomorphology, \*Streams, \*Channels, \*Dams, \*Reservoirs, Rivers, Impoundments, Environmental effects, Sediment, Deposition, Field tests, Headwaters, Erosion, \*Channel morphology, Channel accretion, Channel erosion, Great Britain.

Geomorphological data from 14 impounded rivers located throughout Britain have been used to assess the long-term impact of reservoirs upon river channels downstream, and to identify the potential problems for river management. Changes of channel size and shape have halved the water conveyance capability of 11 of the 14 rivers studied. In the absence of adequate discharge data, two surrogate variables, reservoir surface area and time-to-peak of the reservoir inflow hydrograph, are used to explain the gross variation of channel morphology downstream from reservoirs. Four mechanisms, channel erosion, redistribution of the boundary sediment, channel side deposition, and channel bed aggradation, contributed to the morphological changes. Long-term changes downstream from reservoirs can affect land drainage, coastal stability, water quality, navigation, structural stability, fisheries, and aesthetics, as well as the aquatic flora and fauna. (Titus-FRC) W82-01087

## 7. RESOURCES DATA

### 7A. Network Design

#### ESTIMATION OF MATERIAL FLUXES IN AN ESTUARINE CROSS SECTION: A CRITICAL ANALYSIS OF SPATIAL MEASUREMENT DENSITY AND ERRORS,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research. B. Kjerfve, L. H. Stevenson, J. A. Proehl, T. H. Chrzanowski, and W. M. Kitchens.

Limnology and Oceanography, Vol 26, No 2, p 325-335, March, 1981. 5 Fig, 4 Tab, 12 Ref.

Descriptors: \*Sampling, \*Error analysis, \*Estuaries, \*North Inlet, \*South Carolina, Water quality, Tidal effects.

The minimum number of stations in an estuarine cross section needed to calculate material fluxes within acceptable error limits was determined at North Inlet, South Carolina. Three stations, each representing a separate bathymetric regime, were selected as optimum, giving an error of 15%. To reach this conclusion 10 stations were sampled

every hour for two tidal cycles in a 320 meter wide cross section. Discharge, ATP fluxes, and ammonium fluxes were computed. If the along-channel material flux is the value to be determined, distinct cross-sectional bathymetric regimes should be sampled. Calibration can be used in a well-mixed estuary to give good estimates of cross-sectional discharge or material flux from one or few samples. (Cassar-FRC) W82-00816

#### A COMPARISON OF SENSITIVITY ANALYSIS AND ERROR ANALYSIS BASED ON A STREAM ECOSYSTEM MODEL,

Oak Ridge National Lab., TN.

R. H. Gardner, R. V. O'Neill, J. B. Mankin, and J. H. Carney.

Ecological Modelling, Vol 12, No 3, p 173-190, April, 1981. 5 Fig, 5 Tab, 20 Ref.

Descriptors: \*Streams, \*Sensitivity analysis, \*Error analysis, Mathematical models, Mathematical studies, \*Ecosystems, Prediction, Experimental design, Design criteria.

As ecological modeling techniques are increasingly applied to environmental problems, there is a need for increased understanding of prediction uncertainty and model limitations. Errors due to parameter estimation are particularly important to the modeler and the researcher in the field. One approach to parameter estimation, used when a complex ecosystem model is derived from population interaction theory and physiological ecology, involves determination of individual parameters through independent laboratory or field experiments. Either sensitivity analysis or Monte Carlo error analysis can be used to determine the required accuracy of these parameter values. Both of these analyses attempt to rank order the parameters according to their contributions to overall model error. While sensitivity analysis involves taking the partial derivatives of model equations with respect to individual parameters, error analysis treats each parameter as a random variable and determines the contribution of each parameter to model accuracy by statistical analysis of simulation results. Since both of these techniques can provide the information needed by field researchers, guidelines are needed for choosing the technique most suited to a specific problem. The simple correlation coefficient derived from analysis of Monte Carlo simulations appears to be a reasonable way to rank model parameters according to their contributions to prediction uncertainty. (W82-00991)

## 7B. Data Acquisition

#### HYDROGEOLOGICAL AND GEOPHYSICAL LOGGING,

Wuidart Engineering Ltd., Shefford Beds (England).

Water Services, Vol 85, No 1022, p 187-188, 1981. 1 Fig.

Descriptors: \*Hydrological data collection, \*Measuring instruments, \*Geophysics, Borehole geophysics, Boreholes, \*Logging(Recording), Electrical well logging, Groundwater, Aquifer evaluation, \*Geohydrology.

The logging of temperature and conductivity profiles in boreholes under changing conditions of groundwater flow was seen as a very successful method for investigating many problems of groundwater resources. The method of simultaneous logging of temperature and conductivity forms a basis for the interpretation of groundwater movement; appropriate supporting techniques can then be used in response to particular problems. Such considerations led to the production of the WEL-Micrologger. For investigations of natural gamma radiation both in boreholes and on the surface, a motorized three arm caliper is used with the Micrologger system. The signal is returned to the surface as pulses giving a continuous trace on the chart recorder. The range of the caliper can accommodate boreholes from 50 mm to 1 meter in diameter. The instrument can be used for depth

## RESOURCES DATA—Field 7

### Data Acquisition—Group 7B

sampling and as a flowmeter. The equipment is ideally suited for producing a number of the accepted standard geophysical logs used in the determination and confirmation of formations. (Baker-FRC)  
W82-00511

#### MEASUREMENT OF PH IN THE ESTUARINE ENVIRONMENT ON THE NBS SCALE. (LA MESURE DU PH EN MILIEU ESTUARIEN SUR L'ECHELLE NBS),

McGill Univ., Montreal (Quebec). Dept. of Chemistry.

E. Pelletier, and J. Lebel.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 703-706, April, 1980. 2 Fig, 1 Tab, 9 Ref.

Descriptors: \*Hydrogen ion concentration, \*Measuring instruments, \*Estuaries, Ionic interference, Estuarine environment, Fluctuations, Monitoring, Reproducibility.

A modification to the classical method of measuring pH in estuaries and inshore environments is proposed. The technique employs a secondary standard of high ionic strength to monitor and adjust for the slow drift of electrodes which usually occurs over a long series of analyses on board a ship. The method is accurate to plus or minus 0.010 pH units, with a reproducibility of plus or minus 0.005 pH units for 95% of the analyzed samples. The procedure appears to be insensitive to abrupt changes in ionic strength of successive samples and provides a simple and practical way to study the pH fluctuations of estuarine environments. (Geiger-FRC)  
W82-00521

#### SPRING FLOOD: MELTWATER OR GROUND-WATER.

Uppsala Univ. (Sweden). Div. of Hydrology.

A. Rodhe.

Nordic Hydrology, Vol 12, No 1, p 21-30, 1981. 2 Fig, 2 Tab, 14 Ref.

Descriptors: \*Annual floods, \*Snowmelt, \*Streamflow, \*Groundwater movement, \*Surface-groundwater relations, Infiltration, Watersheds, Tracers, Water level, Oxygen-18, Isotopic tracers, Forest watersheds, \*Sweden.

Stream discharge was separated into two flows: that originating from groundwater and the fresh melt. The environmental isotope oxygen-18 was used as a tracer in this study of two forested watersheds in southern Sweden. The separation is possible due to the seasonal variation of the isotope oxygen-18 in precipitation. The spring flood of 1979 mainly originated from groundwater. Discharged meltwater equaled the total melting over 10-15% of the basins. The results were in agreement with other studies, and the figures were assumed to represent the fraction of effluent area because no infiltration can take place in areas with the groundwater table at (or above) the ground surface. Groundwater was found to play a decisive role in the process streamflow generation; this supports the theory of influent and effluent areas for groundwater. Preliminary results from a similar study in an area situated above the postglacial shoreline indicated a smaller groundwater fraction (about 50%) of the 1980 total spring flood. Two watersheds in the original study were undertaken in basins with outwash moraine soils during a spring when the soil was almost unfrozen. (Small-FRC)  
W82-00531

#### THE USE OF NA/CL RATIOS TO TRACE SOLUTE SOURCES IN A SEMIARID ZONE,

Weizmann Inst. of Science, Rehovot (Israel). Isotope Dept.

M. Margaritz, A. Nadler, H. Koyumdjisky, and J. Dan.

Water Resources Research, Vol 17, No 3, p 602-608, June, 1981. 4 Fig, 1 Tab, 32 Ref.

Descriptors: \*Solute transport, \*Tracers, \*Groundwater recharge, \*Groundwater move-

ment, Sodium, Chlorides, Saline soils, Chemical reactions, Aquifers, Israel, Semiarid lands, Humid areas, Recharge, Rainfall, Dissolved solids, Path of pollutants.

The Na/Cl ratio may be a means of tracing the recharge mechanisms in semiarid regions. In the humid and arid zones, the Na/Cl ratio in groundwater is less than 1; in the transition zone, greater than 1. In this zone the combination of CaCO<sub>3</sub> dissolution and base exchange reactions exists, whereas in humid areas minerals are already well leached and in dry areas the Ca(2+) minerals are not dissolved. An area on the south coastal plain of Israel was studied. Here the Na/Cl ratios change from 0.86-1.0 to 1.5-2.0 from north to south through addition of Na(+) to the groundwater as it interacts with soils of loessial origin. Evidently salt-accumulating profiles do not transfer water downward to the aquifer but add Na(+) salts to the groundwater from the efflorescent crust or from the upper horizon. These waters, now with a high Na/Cl ratio, may flow laterally and percolate through the soil in depressions where they can be found and traced. (Cassar-FRC)  
W82-00601

#### DETERMINATION OF HYDROGEOLOGICAL PARAMETERS USING SINUSOIDAL PRESSURE TESTS: A THEORETICAL APPRAISAL,

Institute of Geological Sciences, Harwell (England). Environmental Protection Unit.

J. H. Black, and K. L. Kipp, Jr.

Water Resources Research, Vol 17, No 3, p 686-692, June, 1981. 3 Fig, 2 Tab, 20 Ref.

Descriptors: \*Diffusivity, \*Aquifer testing, \*Pressure-measuring instruments, Groundwater movement, Hydraulic conductivity, Crystalline rocks, Porous media, \*Borehole geophysics, Geohydrology, Measuring instruments, Permeability, Confined aquifers.

A method of measuring hydraulic diffusivity using sinusoidal pressure fluctuations in an excitation borehole is useful in fissured crystalline rocks but not in high storage/low hydraulic conductivity media such as peat and clay. Equations are derived which describe the dependence of pressures and phase lags outside the excitation borehole on distance, signal frequency, specific storage, hydraulic conductivity, and flow rates. These cover two distinct configurations: that of a point source deep within a water-saturated elastic formation and that of a line source totally penetrating a confined aquifer. For the three-dimensional examination of crystalline rock the signal frequency should be no greater than one cpd with measurement concentrating on the phase shift. Signals are measurable up to 100 meters from the source. For the two-dimensional examination of aquifer rocks in pollution studies, the line source has a more penetrating signal. Measurement would concentrate on the amplitude of the signal, and the excitation frequencies could be on the order of 100 cpd. This method is not seen as a substitute for classical aquifer testing but as a tool to be used in certain applications. (Cassar-FRC)  
W82-00603

#### SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,

Department of Water Affairs, Pretoria (South Africa).

T. P. C. Van Robbroeck.

Civil Engineer in South Africa, Vol 22, No 2, p 34-36, February, 1980. 4 Fig, 1 Tab.

Descriptors: \*Dams, \*Silting, \*Sedimentation, Reservoir silting, Silt load, Silt, Sediments, Measuring instruments.

Use of a sophisticated, automated measuring and calculating method to measure the volume of sediment deposited in a dam over a number of years is described. The dam basin is divided into a number of compartments bounded by accurately measured cross sections taken between permanent silt beacons, the positions of which were determined beforehand. A capacity table is drawn separately for each compartment. End areas of every compart-

ment for each contour interval are determined. Constant factors peculiar to a compartment are derived. To determine the volume of silt deposited, only the end areas of the compartments need to be resurveyed. This is done by electronic means. Echoes from an echo sounder, fitted in a survey boat, are continuously recorded on a chart. Simultaneously, the distance from a shore station is measured and recorded by the rangefinder, an electromagnetic range measuring device. The boat is kept on course between the silt beacons by radio signals from a surveyor observing the mast through a theodolite. The first dam to be surveyed in this manner was Welbedacht Dam on the Caledon River. It is hoped that with this new method surveys of 20 dams can be completed per year, compared to an average of two in the past. Some results of silting in dams already surveyed by this method are presented. (Baker-FRC)  
W82-00680

#### AN IN SITU METHOD FOR MEASURING THE PRIMARY PRODUCTIVITY AND STANDING CROP OF THE EPILITHIC PERIPHYTON COMMUNITY IN LENTIC SYSTEMS,

California Univ., Davis. Div. of Environmental Studies.

S. L. Loeb.

Limnology and Oceanography, Vol 26, No 2, p 394-399, March, 1981. 4 Fig, 2 Tab, 17 Ref.

Descriptors: \*Primary productivity, \*Lentic environment, \*Algae, Periphyton, Substrates, In situ tests, Productivity, Aquatic life, \*Standing crops, Incubation, Sampling, \*Lake Tahoe.

An incubation chamber and quantitative sampler were developed to measure the primary productivity and standing crop of an epilithic periphyton community. The incubation chamber is a hemispherical Plexiglas dome that encloses 200 ml of water over an area of 50 sq cm. The sampler, made of two 60-cc disposable syringes, contains a brushing device and collection device. The apparatus is serviced by SCUBA divers with minimal disturbance to the natural environment. The artificial substrate method underestimated productivity by as much as 95%, and species composition was quite different from that in the in situ method. In this study, measurements were made up to 16 meters deep in Lake Tahoe. (Cassar-FRC)  
W82-00756

#### QUANTITATIVE ASSESSMENT OF TIDAL WETLANDS USING REMOTE SENSING,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.

D. S. Bartlett, and V. Klemas.

Environmental Management, Vol 4, No 4, p 337-345, July, 1980. 6 Fig, 1 Tab, 23 Ref.

Descriptors: \*Wetlands, \*Satellite technology, \*Vegetation, \*Remote sensing, Delaware, Spartina, Biomass, \*Tidal marshes, Marshes, Landsat, Reflectance.

Effective wetlands management requires the collection of information on wetlands condition, which may be directly related to the production and distribution of emergent plant species. Remote sensing techniques were able to quantitatively determine the biomass of *Spartina alterniflora* (salt marsh cord grass) growing in wetlands in Delaware from April through September. Comparisons with the harvest method showed that canopy reflectance measurements in Landsat MSS Bands 4 and 5 (visible spectral region) were inversely related to the % by weight of green vegetation within the canopy. Infrared canopy reflectance was best correlated with green biomass rather than total biomass and canopy height. Spectral methods were not as highly correlated with canopy parameters for the other two species tested: *Spartina patens* and *Distichlis spicata* (salt hay). Seasonal changes in canopy characteristics and reflectance showed that in December, at visible wave lengths, the best potential existed for distinguishing between *S. alterniflora* and the salt hay species. Landsat/MSS digital data for July 31, 1977, was compared with harvest methods at three sites in determining mean green and mean total biomass of *S. alterniflora*.

## Field 7—RESOURCES DATA

### Group 7B—Data Acquisition

Results were encouraging. For example, at Canary Creek Marsh the harvest method determined (all units in g dry weight per sq meter) mean green biomass, 451, and mean total biomass, 1081; Landsat, 407 and 1076, respectively. Woodland Beach results were: harvest, mean green, 820, and mean total, 1376; Landsat, 675, mean green, and 1206, mean total. (Cassar-FRC)  
W82-00781

**MEASUREMENT OF PARTICULATES EX-TRAINED IN SOME GREAT LAKES POWER PLANT COOLING WATER: AN EXERCISE IN UTILITY.**  
Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 6G.  
W82-00782

**THE KYHOLM CORER—A DIVER-OPERATED SEDIMENT CORER.**  
Aarhus Univ. (Denmark), Lab. of Physical Geography.  
P. Nornberg, and C. Christiansen.  
*Sedimentary Geology*, Vol 23, No 1/2, p 1-4, January, 1980. 1 Fig, 8 Ref.

Descriptors: \*Sediment sampler, \*Bottom sampling, Sampling, Bottom sediments, Sand, Sediments, \*Corer.

The Kyholm corer was developed to meet the needs of a study in which it was essential to know the exact location of the sample, necessary to collect compact sandy sediments, and essential to take orientated samples so the cores could be used for paleomagnetic dating. It was also necessary that the corer not be too heavy or too bulky to be handled by SCUBA-divers. The resultant Kyholm corer is easily operated by two SCUBA-divers who place the sampler and drive the corer into the bottom by hammer. The sampler is then hauled up by means of ropes over the divers' shoulders. A cover is placed on the tube as soon as the core has been extracted from the bottom. The sampling procedure involves no twisting, so orientation of the sample is preserved. The corer samples an area of about 28 square centimeters. The prototype has been used to collect 20 samples with a sample depth of 0.9 meters without regard to type of sediment, while a slightly modified version has collected three samples with a sampling depth of 1.95 meters. There have been no problems with retention of the samples nor with disturbance of the vertical stratification. (Carroll-FRC)  
W82-00793

**RELATION OF SATELLITE-BASED THUNDERSTORM INTENSITY TO RADAR-ESTIMATED RAINFALL.**  
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. For primary bibliographic entry see Field 2B.  
W82-00806

**APPARATUS FOR THE SIMULATION OF RAIN IN THE LABORATORY.**  
State Univ. of New York at Albany.  
For primary bibliographic entry see Field 2B.  
W82-00807

**SATELLITE RAIN ESTIMATION IN THE U.S. HIGH PLAINS.**  
National Oceanic and Atmospheric Administration, Boulder, CO.  
For primary bibliographic entry see Field 2B.  
W82-00808

**A PORTABLE PUMP SAMPLER FOR LOTIC PERIPHYTON.**  
Northern Arizona Univ., Flagstaff. Dept. of Biological Sciences.  
J. A. Hamala, S. W. Duncan, and D. W. Blinn.  
*Hydrobiologia*, Vol 80, No 2, p 189-191, May, 1981. 1 Fig, 28 Ref.

Descriptors: \*Water quality, \*Monitoring, Measuring instruments, Sampling, Lotic environment.

Bottom sampling, Sediments, Sediment sampler, \*Substrates, \*Lotic periphyton.

This note describes a simple, inexpensive sampling device and method for use in shallow flowing waters for collecting lotic periphyton on sedimentary substrates. The method offers several advantages: collection and comparison of quantitative samples of periphyton standing crop and colonization rate from intact, submerged substrate of sedimentary origin; establishment of permanent sampling sites on submerged substrata that may be monitored for seasonal or annual water quality programs; and an alternative to floating artificial samplers in areas with high recreational impact that eliminates human disturbance factors. A periphyton sampling program was initiated in May of 1979 at Slide Rock, Arizona, which is a recreation area. Members of the Bacillariophyta (diatoms) comprised the majority of the periphyton occurring on the colonization pads. Removal rates of periphyton from the substrate approached 90% based on sample counts taken from resampled colonization pads. In May of 1980 the periphyton sampling program at Slide Rock continued using the same colonization pads to withstand spring scouring events and associated high discharges indicates the applicability of these pads in ongoing water quality monitoring programs. (Baker-FRC)  
W82-00826

**THE RELATIONSHIP BETWEEN FRACTURE TRACES AND JOINTS IN A TERTIARY BASIN, SOUTHWEST MONTANA.**  
Indiana Univ. at Bloomington. Dept. of Geology.  
N. C. Krothe, and M. P. Bergeron.  
*Ground Water*, Vol 19, No 2, p 138-143, March/April, 1981. 5 Fig, 2 Tab, 13 Ref.

Descriptors: \*Geologic fractures, \*Aerial photography, \*Groundwater mining, Aquifers, Limestone, Groundwater basins, \*Montana, Ground-water potential.

A synclinal basin near Three Forks, Montana, was investigated, and the relationship between fracture traces mapped on aerial photographs and joints mapped in the field, was examined. Fracture traces were mapped in the southern half of Milligan Canyon by stereoscopic examination of 1:20,000 black and white aerial photographs. Fracture traces were transposed from the photographs to a base map using a Saltzman projector. Also, joint and fracture orientations were measured in the field in outcrops of several pre-Tertiary formations. The Madison Group limestone which was measured in the field was a likely artesian system. Regional flow direction was from west to east. A parallelism was found along a north-south and east-west direction which suggested that mapped fracture traces in the study area reflected areas of joint and fracture concentration in the subsurface. Field location of fracture intersections and subsequent drilling should produce high-yield water wells. (Small-FRC)  
W82-00829

**WASTE HEAT BALANCE IN AQUIFERS CALCULATED BY A COMPUTER PROGRAMME.**  
Geologisches Landesamt Nordrhein-Westfalen, Krefeld (Germany, F.R.).  
W. Kley, and W. Heekmann.  
*Ground Water*, Vol 19, No 2, p 144-148, March/April 1981. 6 Fig, 1 Ref.

Descriptors: \*Groundwater reservoirs, \*Heated water, \*Waste heat, Computer programs, Heat, Heat transfer, \*Energy, \*Cologne, Federal Republic of Germany.

For many years, waste heat has been fed into the aquifers of the city of Cologne, Federal Republic of Germany, which has created a subsurface energy resource. A computer program was developed to analyze the temperature measurements in ground water and determine the isolines of the energy resource and of the recoverable amount of heat. This FORTRAN program determines the recoverable amount of heat per square unit and time in terms of heat flux density in  $\text{W}/\text{sq m}$  at a given exhaustion of the energy resource (within 10

and 20 years). A thickness of the ground water range amounting to 10 m is assumed. The results can be applied to plan and design the heat pump units. If heat pumps are not used, in the future a marked temperature rise in the ground water bearing layers will be observed. (Small-FRC)  
W82-00830

**A COMPARATIVE STUDY OF FOUR DREDGES USED FOR SAMPLING BENTHIC MACROINVERTEBRATES IN RIVERS.**  
Freshwater Biological Association, Windermere (England).

J. M. Elliott, and C. M. Drake.  
*Freshwater Biology*, Vol 11, No 3, p 245-261, June, 1981. 6 Fig, 3 Tab, 27 Ref.

Descriptors: \*Benthic environment, \*Sampling, Bottom sampling, Rivers, Aquatic animals, Aquatic plants, Benthos, Aquatic life, \*Dredging, Measuring instruments, Mathematical equations, \*Macroinvertebrates.

Four light-weight dredges were chosen for manual operation from a small boat or the bank to secure samples of benthic macroinvertebrates in rivers. These four were: Irish triangular dredge, small Fast dredge, medium-sized and large Naturalist's dredges. The dredges usually took a similar range of stone sizes at each site, but the design of the Fast dredge was such that it excluded larger stones above 16 mm. The Irish dredge sometimes failed to operate correctly. Variations in the volume of substrate taken with each dredge were large, both between sampling units in the sample and between samples. Penetration depth was greatest for two Naturalist's dredges, smaller for the Fast dredge and smallest for the Irish dredge. The relative abundance of major taxa was similar for most dredges at each site. However, the high variability between sampling units in the same sample and thus a lack of precision in estimates of the mean number of invertebrates per sample makes the dredges unsuitable as quantitative samplers to estimate population density. There was a clear relationship between the number of taxa and the number of invertebrates taken at each site. The relationship was well described by a power law with an exponent within the range 0.18-0.53. The number of sampling units in the sample had no significant effect on the power-law equations for each site. These power-law relationships between number of taxa and number of individuals are probably applicable to samples taken with other equipment used for qualitative sampling such as pond nets and colonization samplers. (Baker-FRC)  
W82-00833

**EVIDENCE OF THE UNSUITABILITY OF GRAVITY CORING FOR COLLECTING SEDIMENT IN POLLUTION AND SEDIMENTATION RATE STUDIES.**  
Glasgow University (Scotland), Department of Chemistry.  
M. S. Baxter, J. G. Farmer, I. G. McKinley, D. S. Swan, and W. Jack.  
*Environmental Science and Technology*, Vol. 15, No 7, p 843-846, July, 1981.

Descriptors: \*Sediments, \*Sampling, Measuring instruments, Cores, Sedimentation, \*Bottom sediments, Water pollution, Water quality.

Inherent dangers, specifically with respect to the not uncommon application of small-diameter gravity coring, in the collection of highly porous unconsolidated sediment as found in many coastal and lacustrine environments are cited. Specific evidence is presented based on the depth distributions of stable lead and manganese, 210-lead, 134-cesium, and 137-cesium in sediment cores collected at the same sites by two different devices: small-diameter gravity cores and a soft-landing hydraulically damped Craig corer. The sediments studied were fine-grained silty clays from the deep basins of two fjordic sea lochs, Loch Goil and Gareloch, of the Clyde Sea area. The material was relatively unconsolidated and highly porous. The gravity core profiles obtained seemed plausible when considered individually. However, discrepancies were observed which point to a substantial (more than 15

## RESOURCES DATA—Field 7

### Evaluation, Processing and Publication—Group 7C

cm) loss of surface sediment using the small-diameter gravity corer. The single most damaging piece of evidence to the credibility of small-diameter gravity coring is the complete absence of <sup>137</sup>Cesium. It is concluded, therefore, that the vertical overlapping of crab and gravity core profiles is not valid, despite the apparently reasonable matching patterns which can emerge on occasion. (Baker-FRC)  
W82-00840

**A COMBINATION OF ELECTRICAL RESISTIVITY, SEISMIC REFRACTION, AND GRAVITY MEASUREMENTS FOR GROUNDWATER EXPLORATION IN SUDAN,**  
Groundwater Survey TNO, Delft (Netherlands).  
For primary bibliographic entry see Field 2F.  
W82-00852

**POSSIBILITY OF USING TRITIUM FOR STUDYING GLOBAL CIRCULATION OF ATMOSPHERIC MOISTURE,**  
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.  
For primary bibliographic entry see Field 2A.  
W82-00863

**EFFECTS OF JOULE HEATING ON THERMOCOUPLE PSYCHROMETER WATER POTENTIAL DETERMINATIONS,**  
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.  
D. C. Slack, and F. R. Riggle.  
Transactions of the ASAE, Vol 23, No 4, p 877-883, July/August, 1980. 10 Fig, 22 Ref.

Descriptors: \*Soil water potential, \*Thermocouples, \*Measuring instruments, \*Soil water, Soil-water-plant relationships, Soil saturation, Psychrometry.

Thermocouple psychrometry has proved useful for the measurement of soil water potential in both laboratory and *in situ* environments. The magnitude and significance of Joule and resistance heating in two types of commercial soil thermocouple psychrometers on water potential determinations near saturation were investigated. The units tested were the Wescor PT51 single junction probe enclosed in a ceramic cup and the Emco PSY-350 double junction probe, which consists of two side-by-side junctions enclosed in a stainless steel cylinder covered on one end by a fine mesh screen. When water potentials were above -4 bars, a significant Joule and resistance heating was produced by a cooling current of 8 milliamperes (mA), resulting in unreliable measurements for both types of probes. The double junction probe was slightly less sensitive to heating than was the single junction probe. Significant reductions in the effects of heating at high water potentials were achieved by reducing the cooling current in the single junction probes to 3 mA. When the double junction probe was used, reduction of the cooling current to 4 mA eliminated heating problems. In each case, the reduced cooling current was applied for 15 seconds and the psychrometer was read 6 seconds after cessation of cooling. Using this procedure, reliable determinations were obtained for soil water potentials between -22 bars and -0.5 bars. Psychrometer response at water potentials below -22 bars was affected by the reduction in cooling current. The magnitude of the cooling current was found to have much more effect on heating than did the duration of the cooling current. (Carroll-FRC)  
W82-00902

**AERIAL PHOTOGRAPHY AS AN AID TO CROPLAND EROSION ANALYSIS,**  
Texas Christian Univ., Fort Worth. Dept. of Geology.  
For primary bibliographic entry see Field 2J.  
W82-00902

**INTERPRETATION OF SURFACE-WATER CIRCULATION, ARANSAS PASS, TEXAS, USING LANDSAT IMAGERY,**  
Texas Univ. at Austin.  
R. J. Finley, and R. W. Baumgardner.

Remote Sensing of Environment, Vol 10, No 1, p 3-22, August, 1980. 12 Fig, 3 Tab, 29 Ref.

Descriptors: Photography, \*Aerial photography, \*Remote sensing, \*Satellite technology, Photogrammetry, Infrared imagery, Sensors, Telemetry, Sedimentation, Sediment concentration, \*Sediment transport, Turbidity, Surface waters, \*Coastal waters, Turbidity flow, Physical properties, Tidal effects, Wind-driven currents, \*Aransas Pass, \*Texas, Gulf of Mexico.

The development of plumes of turbid surface water in the vicinity of Aransas Pass, Texas has been analyzed using Landsat imagery. The shape and extent of plumes present in the Gulf of Mexico are dependent on the wind regime and astronomical tide prior to and at the time of satellite overpass. The best developed plumes are evident when brisk northerly winds resuspend bay-bottom muds and flow through the Pass is increased by wind stress. Wind-influenced surface currents assume greater significance when astronomical tides are low within the coastal bays. Where intense hydrocarbon production and transportation activity may increase the risk of spillage, knowledge of surface current direction under given wind conditions is critical. (Titus-FRC)  
W82-00904

**ATMOSPHERIC WATER CONTENT OVER THE TROPICAL PACIFIC DERIVED FROM THE NIMBUS-6 SCANNING MICROWAVE SPECTROMETER,**

National Environmental Satellite Service, Washington, DC.  
N. C. Grody, A. Gruber, and W. C. Shen.  
Journal of Applied Meteorology, Vol 19, No 8, p 986-996, August, 1980. 10 Fig, 17 Ref.

Descriptors: \*Atmospheric water, \*Tropical regions, \*Meteorological data collection, Climatic data, Satellite technology, \*Remote sensing, Clouds, Precipitation, Moisture content, Microwaves, Radiosondes, Spectrometers.

The scanning microwave spectrometer (SCAMS) aboard Nimbus-6 determined integrated water vapor (precipitable water) and cloud liquid water over the tropical Pacific Ocean between 130 degrees E to 100 degrees W and 35 degrees N to 35 degrees S for the period August 18 to September 4, 1975. The 2 channel measurements, at 22.23 GHz and 31.65 GHz, were used in a nonlinear relationship, which is more accurate than linear model for the large values of precipitable water found in the tropics. The SCAMS values of precipitable water and 163 radiosonde measurements from 19 island stations showed the same variability, with a 0.5 cm rms difference. The Intertropical Convergence Zone was delineated near 10 degrees N and contained > 5 cm precipitable water and > 0.4 mm liquid water. The Southern Convergence Zone was also well demonstrated. The equatorial Pacific dry zone in both hemispheres contained < 3.5 cm of moisture and < 0.2 mm liquid. (Cassar-FRC)  
W82-01004

**DESCRIPTION OF A NEW SUBMERSIBLE FILTER-PUMP APPARATUS FOR SAMPLING PLANKTON,**

Illinois Natural History Survey, Urbana.  
S. W. Waite, and S. M. O'Grady.  
Hydrobiologia, Vol 74, No 2, p 187-191, September, 1980. 4 Fig, 1 Tab, 13 Ref.

Descriptors: \*Submersible pumps, \*Sampling, \*Plankton, Zooplankton, Phytoplankton, Pumps, Filters, Aquatic life, Copepods, Rotifers, Cladocerans, Invertebrates, Rivers, Cooling ponds, Powerplants.

A low volume submersible filter-pump apparatus is useful for collecting zooplankton and other aquatic organisms, especially in rivers and powerplant cooling lakes. Both pump and filter are enclosed in a submersible plexiglass box, forming a unit that weighs only 7.7 kg. The intake diameter, filter mesh size, and rate capacity of the pump may be manipulated to produce the desired total sample volume. A 2 min pumping time with 80 micron

mesh and 1200 gallons per hour pump gives 176 liters of water, equivalent to towing a 13 cm Wisconsin-style plankton net for 17 meters. Compared with conventional tow net samplers, the filter-pump collects greater numbers of rotifers and immature copepods per unit volume and fewer mature copepods. Cladocerans capture rate is similar for both types of apparatus. (Cassar-FRC)  
W82-01012

**A REVIEW ON SEDIMENT TRAPS IN AQUATIC ENVIRONMENTS,**  
Stockholm Univ. (Sweden). Dept. of Geology.  
S. Blomqvist, and L. Hakanson.  
Archiv für Hydrobiologie, Vol 91, No 1, p 101-132, March, 1981. 15 Fig, 2 Tab, 240 Ref.

Descriptors: \*Aquatic environment, \*Sediments, \*Trap efficiency, \*Bottom sediments, \*Suspended solids, Reviews, Measuring instruments, Experimental design, Design standards, Sediment traps, Sediment samples.

The use of trap devices for the collection of sedimentating material is becoming increasingly important in the study of aquatic systems. A broad literature review was conducted in an effort to identify various types of sediment traps suitable for use in aquatic environments and to evaluate the benefits and limitations of these devices. Bottom sediment traps may be located either at the sediment surface or above the sediment surface in the water phase. Buoy-carried sediment traps may be either moored or free-drifting. Selection of the type of sediment trap should be based on the purpose of the investigation. The results obtained will depend on the environment in which the trap is placed. Bottom sediment traps should be used only within zones of accumulation, while buoy-carried traps will yield best results if placed in a hydrodynamically calm environment. The sediment vessel must be kept in a horizontal position throughout the registration period. The geometry and size of the sediment collection vessel are important factors controlling the results. Negative edge effects often result from the use of unsymmetric and/or angular sediment vessels. Cylindrical vessels with narrow orifices may collect a disproportionate amount of organic material in non-stagnant waters. Marking and rigging devices for buoy-carried traps need to be improved. Free drifting sediment traps require further investigation. The relationships among deposition, Reynolds number, and height-diameter ratios for cylindrical vessels need to be studied, as does the relationship between orifice area and trapping efficiency in these vessels. The complex of selective trapping and qualitative representativity of deposited matter in sediment vessels needs to be evaluated. (Carroll-FRC)  
W82-01020

**SOIL PERCOLATION TESTS,**  
Indian Health Service, Seattle, WA. Office of Environmental Health.  
For primary bibliographic entry see Field 2G.  
W82-01044

### 7C. Evaluation, Processing and Publication

**SUMMARY APPRAISAL OF WATER RESOURCES IN THE REDMOND QUADRANGLE, SANPETE AND SEVIER COUNTIES, UTAH,**

Geological Survey, Salt Lake City, UT. Water Resources Div.  
D. Price.  
Br. of Distr. USGS Box 25286, Fed. Ctr. Denver, CO 80225. Price: \$1.50. Geological Survey Miscellaneous Investigations Series Map I-1304-B, 1981. 1 Sheet, 11 Ref.

Descriptors: \*Maps, \*Surface water, \*Groundwater, \*Water quality, Water supply, Aquifer, Wells, Water yield, Dissolved solids, \*Utah, Redmond quadrangle, Sevier River basin.

The Redmond Quadrangle is in the central Sevier River valley about 105 miles south of Salt Lake

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

City, Utah. The Sevier River, which flows northward through the quadrangle, is the principal source of surface water for the area. Average annual (1912-78) flow of the river were gaged, about 12 miles south of the quadrangle, is about 68,000 acre-feet (excluding upstream irrigation diversions). The principal source of ground water in the Redmond Quadrangle is the unconsolidated valley fill that underlies the Sevier River valley plain. The fill contains an estimated 120,000 acre-feet of recoverable water. It is tapped by many small-diameter domestic and stock wells, most of which produce less than 100 gallons per minute of water. However, available data indicate that the fill could yield several hundred gallons per minute to properly located and constructed large-diameter wells. Dissolved-solids concentrations of the surface water generally exceed 500 mg/L and periodically exceed 1,000 mg/L during low-flow periods. Dissolved-solids concentrations of the ground water also generally exceed 500 mg/L and can be expected to exceed 1,000 mg/L in many parts of the quadrangle. The principle source of the dissolved solids is the Arapian Formation of Jurassic (and Tertiary) age, which underlies much of the Redmond Quadrangle (including the valley fill) and adjacent areas. This formation contains large amounts of salt and other easily dissolved evaporite deposits. (USGS)

W82-00725

**POTENIOMETRIC-SURFACE MAP FOR THE CRETACEOUS AQUIFER, VIRGINIA COASTAL PLAIN, 1978,**  
Geological Survey, Richmond, VA. Water Resources Div.

H. T. Hopkins, R. F. Bower, J. M. Abe, and J. F. Harsh.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$2.50 in paper copy, \$0.50 in microfiche. Geological Survey Open-File Report 80-965 (WRI), 1981. 1 Sheet, 11 Ref.

Descriptors: \*Maps, \*Groundwater, \*Potentiometric level, \*Aquifers, Geohydrology, Groundwater mining, Water use, Water supply, Wells, Water level, Subsidence, \*Virginia, Coastal Plain.

The Atlantic Coastal Plain of Virginia includes 9,600 square miles—all or part of 40 counties east of the Fall Line. The undifferentiated Cretaceous sediments underlying this area are the most productive and extensive source of ground water, from which large withdrawals have been made over the past 40 years. In 1978, withdrawals exceeded 100 million gallons per day. To determine the effect of continued withdrawals, annual synoptic water levels for 1978 were used to prepare a map showing the approximate configuration of the potentiometric surface. (USGS)

W82-00727

**POTENIOMETRIC SURFACE OF THE WILCOX-CARRIZO AQUIFER; BIENVILLE, RED RIVER, NORTHERN NATCHITOCHES, AND SOUTHERN WEBSTER PARISHES, LOUISIANA,**

Geological Survey, Alexandria, LA. Water Resources Div.

G. N. Ryals.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$1.00 in paper copy, \$0.50 in microfiche. Geological Survey Open-File Report 80-1179, 1980, 1 Sheet.

Descriptors: \*Maps, \*Potentiometric level, Aquifers, \*Groundwater, Geohydrology, Contours, Water level fluctuations, Wells, Data collections, \*Louisiana, \*Wilcox-Carrizo aquifer.

The potentiometric surface of the Wilcox-Carrizo aquifer in central northwestern Louisiana is shown by contours using data collected from 1960 to 1980. The aquifer is not affected by regional water-level declines as no large pumping centers have been developed. Seasonal water-level fluctuations in wells are generally less than 10 feet annually. (USGS)

W82-00728

**GENERALIZED THICKNESS OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,**  
Geological Survey, Tallahassee, FL. Water Resources Div.

R. M. Wolansky, and J. M. Garbade. Geological Survey Open-File Report 80-1288 (WRI), 1981. 1 Sheet, 30 Ref.

Descriptors: \*Maps, \*Confined aquifers, \*Aquifer characteristics, \*Groundwater, Geohydrologic units, Geohydrology, Wells, \*Florida, \*Floridan aquifer, Southwest Florida Water Management District.

This map report presents the thickness of the Floridan aquifer in the Southwest Florida Water Management District. The Floridan aquifer ranges in thickness from 600 feet in the northern part of the District to 2,400 feet in the southern part. It is composed chiefly of limestone and dolomite beds that range in age from early Miocene to middle Eocene. For this investigation, the formations considered to be part of the Floridan aquifer are: Lake City and Avon Park Limestones of middle Eocene age; Ocala Limestone of late Eocene age; Suwannee Limestone of Oligocene age; and permeable parts of the Tampa Limestone and Hawthorn Formation of Miocene age that are in hydrologic contact with the rest of the aquifer. (USGS)

W82-00729

**WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1980—VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN,**

Geological Survey, Urbana, IL. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as 82-106311, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-80-1, 1981. 708 p, 4 Fig.

Descriptors: \*Hydrologic data, \*Surface water, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, \*Illinois.

Water resources data for the 1980 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 98 gaging stations, stage only at 5 gaging stations, stage and contents at 3 lakes and reservoirs, stage only at 1 lake station, and water quality at 125 gaging stations and 43 wells. Also included are data for 38 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)

W82-00731

**WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1980—VOLUME 2. ILLINOIS RIVER BASIN,**

Geological Survey, Urbana, IL. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-106220, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-80-2, 1981. 468 p, 4 Fig.

Descriptors: \*Hydrologic data, \*Surface water, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, \*Illinois, \*Illinois River basin.

Water resources data for the 1980 water year for Illinois consist of records of stage, discharge, and

water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 85 gaging stations, stage only at 2 gaging stations, stage only at 3 lake stations, water quality at 97 gaging stations and 33 wells, and water levels at 3 observation wells. Also included are data for 44 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)

W82-00732

**WATER RESOURCES DATA FOR UTAH, WATER YEAR 1980,**

Geological Survey, Salt Lake City, UT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108606, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report UT-80-1, 1981. 684 p, 12 Fig.

Descriptors: \*Hydrologic data, \*Surface water, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, \*Utah.

Water resources data for the 1980 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 294 gaging stations; stage and contents for 22 lakes and reservoirs; water quality for 64 hydrologic stations, 194 partial-record stations, and 323 wells; and water levels for 36 observation wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (USGS)

W82-00733

**APPROXIMATE GROUND-WATER-LEVEL CONTOURS, APRIL 1981, FOR THE SOQUEL-APTOS AREA, SANTA CRUZ COUNTY, CALIFORNIA,**  
Geological Survey, Menlo Park, CA. Water Resources Div.

R. M. Bloyd.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$3.25 in paper copy, \$4.00 in microfiche. Geological Survey, Open-File Report 81-680, June 1981. 3 p, 1 Fig, 2 Ref.

Descriptors: \*Groundwater, \*Water level, \*Maps, \*Contours, Aquifers, Groundwater movement, Wells, Pumping, \*California, Santa Cruz County, Soquel-Aptos area, Water-level declines.

Ground-water levels in selected wells were measured in the Soquel-Aptos, Calif., area in April 1981. On the basis of these measurements approximate ground-water-level contours were constructed. The general direction of ground-water movement in the Soquel-Aptos area is from the ridges in the northern part of the area, toward the adjacent canyons, and then southward toward the ocean. Ground-water pumping has caused ground-water levels to decline below sea level in the Capitola area, in the area just to the west and northwest of Aptos, and in isolated local areas southwest of Rio Del Mar. Ground-water levels in the northern part of the area away from the coast have not declined much over time. (USGS)

W82-00734

## ENGINEERING WORKS—Field 8

### Hydraulics—Group 8B

#### 8. ENGINEERING WORKS

##### 8A. Structures

**SMALL HYDRO INSTALLATIONS SPUR UNIQUE ENGINEERING SOLUTIONS,**  
Tudor Engineering Co., Riverton, WY.  
For primary bibliographic entry see Field 6B.  
W82-00538

**MODELING GRADUAL DAM BREACHES,**  
San Diego State Univ., CA. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 8D.  
W82-00554

**RELIABILITY OF UNDERGROUND FLOOD CONTROL SYSTEM,**  
Arizona Univ., Tucson, Dept. of Systems and Industrial Engineering.  
L. Duckstein, I. Bogardi, and F. Szidarovszky.  
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 817-827, July, 1981. 3 Fig, 1 Tab, 13 Ref.

Descriptors: \*Mining engineering, \*Flood protection, \*Karst hydrology, Flood control, Drainage, Underground structures, Grouting, Protection, Pumping plants, Tunnel failure, Sediment control, Manyi, Hungary.

A reliability model of an underground hydraulic engineering system for protecting mines against inflows or inundations of water is presented. This paper considers the probability that a flood control system will fulfill its function within a given time interval. The scope covers only equipment protection, not personnel escape routes. The recommended approach for studying these complex failure events is a failure tree analysis followed by Monte Carlo simulation. Possible failure events are flooding in faces, flooding in blocks, simultaneous disturbances in several blocks, and flooding of mines. A protection system may include face protection, water cut of faces, block water cut, mine water cut, sediment settler and removal equipment, and central pumping station. An example uses the Manyi mine, Hungary, which is 300 meters below the karstic water level. Two alternative protection methods are evaluated: INSTANTAN (which provokes inrushes before full-scale mining starts) combined with artificial sealing (moderate and high), and passive control (a drainage system). Results, depicted on bar graphs, can be used in design of the protection scheme. (Cassar-FRC)  
W82-00556

**WHY EPA'S L/I CONTROL PROGRAM FAILS,**  
Westech Engineering, Inc., Salem, OR.  
C. H. Steketee.  
Public Works, Vol 112, No 7, p 51-53, July, 1981. 3 Fig, 1 Tab.

Descriptors: \*Sewer systems, \*Infiltration, \*Rehabilitation, Leakage, Water mains, Pipes, Maintenance, Economic aspects.

An evaluation of the EPA program to reduce infiltration/inflow (I/I) in sewer systems showed that generally the program has not been effective, especially in older systems. In 18 communities the percent reduction achieved was 0 to 60% in 8 cases, an increase in 3 cases, and no information available for 5 cases. Some of the problems encountered are water-transmitting backfill materials, piping and erosion around the sewer pipes, storm-induced infiltration, difficulties in identifying the location of leaks in surcharging sewers, transference of leaks to other locations as holes are repaired, and the necessity to fix nearly all the leaks in a section to make a significant improvement. Some suggestions learned from experience are: (1) sometimes 3 years are required to significantly reduce I/I, (2) annual reevaluation should follow evaluation and repairs, (3) the cheapest techniques should be used first, (4) upstream problems should be dealt with before downstream problems, (5) a

complete renovation is more effective than making scattered repairs, (6) all leaky joints must be grouted, and (7) all system components must be repaired, not just leaky mains and manholes. (Cassar-FRC)  
W82-00790

**FACTORS INFLUENCING THE OCCURRENCE OF BURSTS IN IRON WATER MAINS,**  
Severn-Trent Water Authority (England).  
R. Newport.  
Aqua, No 3, p 274-278, 1981. 10 Fig, 2 Ref.

Descriptors: \*Water mains, \*Pipes, \*Iron, Water distribution, Metal pipes, Corrosion, Water loss, Leakage, Pipelines, Soil types, Frost, Frozen ground, Materials engineering, \*Pipe failure, Seven-Trent Water Authority, \*Great Britain.

A statistical study on burst water mains in the Severn-Trent Water Authority revealed two major causes of failure: ground loading (frost, drought, and soil type) and corrosion (soil type, water, and pipe material). A winter peak in bursts is caused by frosts, especially those earlier in the season. The relationship may be described as: Total bursts per year = 2.5 x Total degrees of frost + 500. The magnitude of this peak can identify areas where corrosion is severe. Summer peaks, less common, appear during severe drought and are caused by ground movement as the earth cracks. Age cannot be correlated well with pipe failure. However, the spun iron pipes laid since 1952 have the highest burst rate, 0.39 burst per km per year. These show fissure corrosion resulting in a circumferential break upon stress. Average burst rates for four areas with cast iron pipes dating back to 1890 are 0.08 to 0.12 burst per km per year. Other factors affecting failure rate are: soil type (pipes laid in clay soils have twice the burst rate of those in sand and gravel), water type (soft water is worst), traffic loading, and accidental damage (during construction or before installation). (Cassar-FRC)  
W82-00960

**A NEW LOOK AT DESIGN OF RAW WATER PIPING,**  
C. F. Bowman, and W. S. Bain.  
Power Engineering, Vol 84, No 8, p 73-77, August, 1980. 8 Fig, 1 Tab.

Descriptors: \*Pipelines, \*Design criteria, \*Corrosion, Steel, Materials, Raw water, Conveyance structures, Pressure distribution, Temperature effects, Aeration, Oxidation, Water pressure, Hydraulic roughness.

A study was undertaken to determine the extent of the problem of materials building up on the inside of pipelines in the Tennessee Valley Authority system. Some recommendations are made for procedures to help mitigate this problem in the design of future power plants. About 50 sections of carbon steel raw water piping were removed from nine different TVA steam plants. Normally stagnant and normally flowing piping systems were sampled as well as both vertical and horizontal runs of pipe. The primary mechanism of material build-up was corrosion of the steel piping by aerated river water and redeposition of the corrosion products. The result is random pitting in the pipe wall and the formation of a tubercle over each pit. Pressure drop tests were performed at several plants to evaluate the effects of corrosion product buildup on pressure drop. The results of this study should have a profound impact on the design of future raw water piping systems, as the pressure drops calculated by methods recommended herein are significantly greater than those which would be calculated by presently recognized standard methods. These findings apply only to friction losses and should not be applied to form losses. (Baker-FRC)  
W82-01029

#### 8B. Hydraulics

**FRONTAL JUMP CONDITIONS FOR MODELS OF SHALLOW, BUOYANT SURFACE LAYER HYDRODYNAMICS,**

Delaware Univ., Newark, Coll. of Marine Studies. R. W. Garvine.  
Tellus, Vol 33, No 3, p 301-312, June, 1981. 7 Fig, 22 Ref.

Descriptors: \*Mathematical models, \*Hydrodynamics, \*Flow characteristics, Coastal waters, Interfaces, Thermocline, Thermal stratification, Hydraulic jump, Fluid mechanics, Lakes, Temperature effects, Saline-freshwater interfaces.

A shallow, buoyant upper layer is often found overlying heavier water of substantially greater depth in both coastal and inland waters. Examples of these moving frontal regions include surface plumes of buoyant water originating from a nearby source and the surface layer above the thermocline in lakes. This paper discusses an approach to modeling the hydrodynamics of these surface layers in which the flow field is partitioned into a frontal region where dissipative effects are important and an internal wave region in which they are not. The frontal region is treated as a horizontal discontinuity described by appropriate jump conditions. The wave region is described by nonlinear, long internal wave equations. Frontal jump conditions, which account for the transport of mass and momentum across the interface with the underlying fluid, are derived for use in applications of the model to small-scale flows where earth rotation has a negligible effect. These jump conditions are also applicable to flows where the depth of the buoyant layer vanishes on the upstream side of the front. The solution of a problem representing the sudden release of a shallow, buoyant upper layer into an unbounded domain is used to demonstrate the use of frontal jump conditions in conjunction with nonlinear internal wave equations. Although the results for zero interfacial transport are identical to the classical description of the analogous single layer problem posed by the sudden breaking of a dam, new features of the flow arise for non-zero transport. (Carroll-FRC)  
W82-00804

**HYDRAULIC DESIGN FOR THE TWO-STAGE STILLING BASIN,**  
Saskatchewan Univ., Saskatoon, Dept. of Civil Engineering.  
C. D. Smith, and M. J. Klassen.  
Canadian Journal of Civil Engineering, Vol 8, No 2, p 137-145, June, 1981. 12 Fig, 3 Tab, 5 Ref.

Descriptors: \*Stilling basins, \*Design criteria, \*Hydraulic design, Hydraulic jump, Tailwater, Basins, Mathematical studies, Hydraulic models.

The two-stage stilling basin is a design sometimes used for high head energy dissipating structures. Such stilling basins are often located in deep excavations because otherwise the natural tailwater is insufficient to force a hydraulic jump. The existence of two hydraulic jumps occurring in series in the same structure is the distinguishing feature of the two-stage stilling basin design. The tailwater depth for the first jump is created by a fixed weir at the end of the first basin. The jump in the second basin is forced by the natural tailwater depth in the downstream channel. Dissipation of most of the energy of flow in the first jump results in a considerable decrease in the required tailwater depth necessary to produce a jump in the second basin. Although the two-stage basin is substantially longer than the single-stage basin, the cost advantages of a higher floor elevation more than offset the costs of the extra length in some cases. Several hydraulic model tests for a two-stage stilling basin were conducted. The performance of the hydraulic jump in close proximity to a weir was first studied for two-dimensional flow using a parallel side flume. A design criterion was developed which was then verified on a three-dimensional model. Recommended values for the length of the first basin, length of the second basin, weir coefficient, weir shape, and weir height are included. (Carroll-FRC)  
W82-00849

**HYDRAULIC MODEL STUDY FOR THE DESIGN OF THE WRECK COVE CONTROL GATES,**

## Field 8—ENGINEERING WORKS

### Group 8B—Hydraulics

McMaster Univ., Hamilton (Ontario). Dept. of Mechanical Engineering.  
D. S. Weaver, and W. W. Martin.  
*Canadian Journal of Civil Engineering*, Vol 7, No 2, p 304-314, 1980. 14 Fig. 8 Ref.

Descriptors: \*Hydraulic gates, \*Reservoirs, \*Flow characteristics, Model studies, Gates, Wreck Cove, \*Nova Scotia, Powerplants, Outlets, Control systems, Oscillatory waves, Hydraulic models, Hydraulic design.

Scale model studies in a water tunnel were used to test the proposed configuration for the Wreck Cove, Nova Scotia, power plant vertical lift control gates. The gates are expected to operate under reasonable downpull loads and not suffer from sustained flow-induced oscillations. Gates of similar geometry are planned upstream of the control gate and at two locations further upstream in the reservoir network. These locations differ in probable head, flow rate, and downpull. The data obtained from the model studies agree with previous results from sealed two-dimensional wind tunnel models. Maximum overall downpull coefficient is 0.4 and occurs at a gate opening of 45%. Gate slots do not significantly affect the maximum downpull coefficient or the relative opening at which it occurs. However, the downstream free surface increases the maximum downpull coefficient by about 5%. Removal of the curve fairing the bevelled gate bottom into the vertical face produces flow separation and significant buffeting of the gate. Changing the arrangement so that the bevel is downstream greatly increases downpull and could result in significant buffering if the bevelled face is submerged. (Cassar-FRC)  
W82-00880

#### DEVELOPMENT OF MAKEUP-LINE SAFE OPERATING CRITERIA, Bechtel Inc., Norwalk, CA.

P. K. Su, and I. Joseph.

*Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers*, Vol 106, No HY2, p 269-283, February, 1980. 10 Fig. 2 Tab. 1 Ref.

Descriptors: \*Mathematical models, \*Powerplants, \*Pipelines, Head loss, Pumping plants, Water treatment facilities, Maintenance, Operating policies, \*Navajo Generating Station, Arizona.

A field experiment and mathematical analysis of the hydraulic transients were performed on the makeup lines of the Navajo Generating Station, located in northcentral Arizona near the border of Utah. The station is a three-unit, coal-fired power plant. Its makeup system, including the lake pumping station and two parallel pipe lines, conveying water from Lake Powell to the water-treatment facility at the plant site. The water is used as a makeup supply for evaporation losses and blowdown from the cooling towers of the main condenser circulating water system. After adjusting the head-loss coefficients of the pipeline and the air-chamber nozzle in the mathematical model, the results show a satisfactory agreement between the measured and calculated transient response at the air chambers and several points along the pipeline. The mathematical model was next used to develop system operating criteria that include automatic control of the water levels in the air chamber for various flow rates. The system is protected from adverse transient effects due to power interruptions. (Baker-FRC)  
W82-01095

#### 8D. Soil Mechanics

##### MODELING GRADUAL DAM BREACHES, San Diego State Univ., CA. Dept. of Civil Engineering.

V. M. Ponce, and A. J. Tsivoglou.

*Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers*, Vol 107, No HY7, p 829-838, July, 1981. 1 Tab, 25 Ref.

Descriptors: \*Dam failure, \*Erosion, Embankments, Earth dams, Model studies, Mathematical

models, Channel morphology, Bank erosion, Flood peak, \*Huacoto Dam, Mantaro River, \*Peru, Hydrographs, Reservoirs, Earthquakes, Landslides.

A simulation model of the gradual failure of an earth embankment dam was formulated, developed, and tested. Concepts of water and sediment routing and channel geometry were used to develop a self-contained mathematical model of the breach enlargement and the ensuing flood wave. Unsteady flow elements of the simulation are an implicit numerical solution of the complete Saint Venant equations coupled with a sequential sediment routing technique. The model was tested on the failure of a natural embankment formed by an earthquake landslide at Huacoto on the Mantaro River, Peru, in April, 1974. The failure of this 170 meter high, 3800 meter long embankment holding back 665 million cu meters of water occurred by overtopping. This developed a breach which grew under the erosive action of the waters for 48 hours, a period much longer than the usual few hours failure time documented for engineered dams. Comparisons between estimated actual and simulated flood characteristics were remarkable. Actual and simulated values were as follows, respectively: peak discharge, 13,700 and 13,200 cu meters per sec; maximum crest erosion, 35 and 37 meters; maximum flow depth, 15-20 and 12-22 meters; time from 0 to 100 cu meters per sec, both 16 hours; time from 100 cu meters per sec to peak discharge, both 10 hours; and hydrograph duration from 100 cu meters per sec to peak and recession, 32 and 34 hours. (Cassar-FRC)  
W82-00554

##### SETTLEMENT OF A COMPACTED UNSATURATED EARTH EMBANKMENT, University of the Witwatersrand, Johannesburg (South Africa).

G. E. Blight, G. H. H. Legge, and G. W. Annandale.

*Civil Engineer in South Africa*, Vol 22, No 2, p 25-29, February, 1980. 6 Fig. 16 Ref.

Descriptors: \*Dams, \*Soil compaction, Soil engineering, Soil mechanics, Sedimentation, \*Mita Hills Dam, Mathematical studies, South Africa, Dam design, Settlement analysis.

A settlement analysis of the Mita Hills Dam, made during its design in 1956-57, has been reexamined in the light of current soil mechanics knowledge and computational procedures. The Mita Hills Dam embankment has a maximum height of 48.8 meters, a crest length of 366 meters, and consists of some one million cubic meters of rolled earth-fill. The entire downstream zone of the fill is protected from seepage by the inclined filter drain, while 12 pore pressure relief drains were provided in the heart of the downstream zone to relieve construction pore pressures. The time-settlement and void ratio-pressure characteristics of the Mita Hills soil had been measured by means of standard oedometer test techniques on specimens of soil taken from the proposed borrow pits. The difference between the original analysis and the analysis conducted in recent years indicated the results of post-construction consolidation. Use of more modern computational skills has enabled the prediction of post-construction settlement of a compacted earth embankment with increasing accuracy. The improved accuracy results more from computational improvements than from improvements in the area of soil mechanics understanding. (Baker-FRC)  
W82-00678

##### LARGE RUBBLE-MOUND BREAKWATER FAILURES, Harrington (Frederic R.) Inc., Houston, TX.

E. H. Harlo.

*Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers*, Vol. 106, No. WW2, p 275-278, 1980. 1 Fig, 8 Ref.

Descriptors: \*Coastal waters, \*Breakwaters, \*Jetties, \*Sea walls, \*Construction, Engineering, Dam construction, Construction materials, Construction methods, Stress, Stability analysis, Storms, Damage, Foundation failure.

The mechanism by which waves cause large internal water pressures and cause breakwater failures is outlined. Hydrodynamic pore pressures in the core material contribute significantly to the failure of rubble-mound structures. Steep slopes cause larger seepage pressures in the direction of incipient failure planes. The smaller the permeability of core materials next to the filter rock, the larger will be the seepage pressures along these planes. Model study of the phenomenon is recommended. This should include determination of the angle of internal friction of the core material, maximum instantaneous seepage pressures in the core, and dynamic analysis of slope stability for various breaking wave patterns at a series of stages during the maximum wave cycle. (Titus-FRC)  
W82-00862

## 8G. Materials

#### SUCCEEDING WITH LINER INSTALLATION, Water and Sewage Works, Vol 127, No 4, p 60-61, April, 1980. 1 Fig.

Descriptors: \*Linings, \*Reservoir linings, Ponds, Lagoons, Coating, Reservoirs.

The importance of installation technique in the application of a lining is discussed. Regardless of the type of lining membrane used, the success will depend to a very large extent on the experience and expertise of the installer. Information needed about the liner in order to make a selection includes a study of the compatibility of the liner material and scrims with the process fluids involved. A temperature test must be made of the fluid when it is injected into the pond as well as at its standing temperature. Injection and withdrawal methods must be examined, including the number and types of monitoring or inspection facilities that may be needed. The volume of liquid to be stored must be known, as well as length, width, depth, and side slope ratio of the pond. The type and condition of the soil, groundwater table and surrounding terrain as well as the location of the pond and the high and low temperatures experienced in the area must be known. Installation cost must be carefully computed before making final decisions. (Baker-FRC)  
W82-00909

## 8I. Fisheries Engineering

#### FACTORS AFFECTING PUGET SOUND COHO SALMON (ONCORHYNCHUS KISUTCH) RUNS,

Washington Univ., Seattle. Coll. of Fisheries.

S. B. Matthews, and F. W. Olson.

*Canadian Journal of Fisheries and Aquatic Sciences*, Vol 37, No 9, p 1373-1378, September, 1980. 2 Fig, 2 Tab, 16 Ref.

Descriptors: \*Salmon, \*Streamflow, \*Fish populations, Fish management, Fisheries, Fish hatcheries, Temperature effects, Dissolved oxygen, Mathematical studies, Seasonal variation, Runoff, \*Puget sound, Washington, Water quality.

During their freshwater stream residence, juvenile coho salmon (*Oncorhynchus kisutch*) may be subject to such stresses as high temperature, predation, low dissolved oxygen, disease, stranding and overcrowding. These factors have been associated with streamflow conditions and may affect salmon populations. Hatchery production of salmon has also had a significant effect on coho population growth. A relationship has been recognized between rearing flow conditions and coho run strength for more than 40 years. It was theorized that the survival of hatchery coho may be positively related to the same environmental conditions that affect the stream-reared salmon. A dependency mortality relationship between abundances of stream-reared and hatchery coho similar to that observed in pink salmon was suggested. (Geiger-FRC)  
W82-00883

**SCIENTIFIC AND TECHNICAL INFORMATION—Field 10**

**Specialized Information Center Services—Group 10D**

**GREAT LAKES ENVIRONMENTAL PROTECTION POLICIES FROM A FISHERIES PERSPECTIVE,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 6G.  
W82-00978

**GONAD DEVELOPMENT, FECUNDITY, AND SPAWNING SEASON OF LARGEMOUTH BASS IN NEWLY IMPOUNDED WEST POINT RESERVOIR, ALABAMA-GEORGIA,**  
Alabama Cooperative Fishery Research Unit, Auburn.  
For primary bibliographic entry see Field 2H.  
W82-01080

**9. MANPOWER, GRANTS AND FACILITIES**

**9A. Education (Extramural)**

**FACTS FIX FUND FINDING,**  
Havens and Emerson Ltd., Cleveland, OH.  
G. D. Simpson.  
Water and Sewage Works, Vol 127, No 4, p 56, 84,  
April, 1980. 1 Tab, 5 Ref.

Descriptors: \*Government finance, \*Water treatment, \*Wastewater treatment, Economic aspects, Training, Government supports, Grants, Legislation, Education.

Grants, loans, training and advisory services, and information services are among the programs available from the Federal and state governments to assist municipalities and sewer districts in discharging their responsibilities. Federal legislation in this area is contained primarily in the Water Pollution Control Act and the Clean Water Act, as well as the Safe Drinking Water Act and the Resource Conservation and Recovery Act amendments to the Solid Waste Disposal Act. Support includes grants for research and investigative studies, financing of pilot programs, grants to assist in costs for technical evaluation of operation and maintenance for demonstration projects, costs for technical evaluation of operation and costs of certain training, and scholarships to individuals for college training in the field of operation and maintenance of treatment works. Means of contacting various agencies are listed. (Baker-FRC)  
W82-00885

**10. SCIENTIFIC AND TECHNICAL INFORMATION**

**10D. Specialized Information Center Services**

**POINT-OF-USE WATER TREATMENT...AN ENLARGING REALITY,**  
L. Vinyard.  
Water and Sewage Works, Vol 127, No 4, p 8,  
April, 1980.

Descriptors: \*Organizations, \*Water quality control, Water Quality management, Water quality standards, Professional societies, Professional personnel, \*Water treatment, Information retrieval, \*Water quality association.

The Water Quality Association (WQA) is the spokesman for the point-of-use water-treatment industry, which provides water treatment technology for systems ranging from a single home faucet to municipal treatment for small communities. The industry consists of more than 200 manufacturers and nearly 5000 retailers. The WQA is frequently contacted to provide information needed by legislators as they attempt to formulate needed legislation and governmental approaches to solving current problems. Future research conducted by the WQA will include an analysis of economics and a possible demonstration project. (Baker-FRC)  
W82-00784



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### NORTH AMERICAN CONTINENT PRICE SCHEDULE

Customers in Canada, United States, and Mexico  
please use this price schedule; other addresses  
write for Folder PR-360-4.

A01	\$4.00	E01	\$6.50	701	\$110.00
A02	6.00	E02	7.50	702	125.00
A03	7.50	E03	9.00	703	210.00
A04	9.00	E04	11.50	704	300.00
A05	10.50	E05	13.50	704	360.00
A06	12.00	E06	15.50	706	420.00
A07	13.50	E07	17.50	707	480.00
A08	15.00	E08	19.50	708	540.00
A09	16.50	E09	21.50	709	600.00
A10	18.00	E10	23.50	710	660.00
A11	19.50	E11	25.50	711	720.00
A12	21.00	E12	28.50	712	780.00
A13	22.50	E13	31.50	713	840.00
A14	24.00	E14	34.50	714	900.00
A15	25.50	E15	37.50	715	960.00
A16	27.00	E16	40.50	716	1,020.00
A17	28.50	E17	43.50	717	1,080.00
A18	30.00	E18	46.50	718	1,140.00
A19	31.50	E19	51.50	719	1,200.00
A20	33.00	E20	61.50	719	.....*
A21	34.50	E21	.....	719	.....*
A22	36.00	E22	.....	719	.....*
A23	37.50	E23	.....	701	30.00
A24	39.00	E24	.....	702	50.00
A25	40.50	E25	.....	703	.....*

\*Contact NTIS for price quote

PRICES EFFECTIVE JANUARY 1, 1982

